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BRAN

REPORT

ON THE

Landed Property

OF THE

Buena Vista Company.

BY

W. H. RUFFNER.

PHILADELPHIA:
Dando Printing and Publishing Co.,
34 South Third Street.
1889.

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TOPOGRAPHY.

THE landed estate of the Buena Vista Company has been made up by the consolidation of the historic iron and agricultural lands of Samuel F. Jordan, deceased, known as the Buena Vista property, the Green Forest farm and the Hart's Bottom farm; all together making about 13,000 acres, and forming a compact, well-shaped body. These lands are wholly in Rockbridge County, within five miles of Lexington, twelve miles of Balcony Falls, and fifteen miles of the Natural Bridge. They lie on the west flank and at the base of the Blue Ridge, and include bottom lands on North River and South River, wide foot-hills and plateaux, high spurs and outstanding peaks, the last connected with the main Blue Ridge by "saddles" or cross ridges. The boundary lines of the property run for five miles along the crest of the mountain.*

The bottom lands have a front of one and a half miles on North River, a branch of the James, and one mile on South River, which flows through the western prolongation of the tract. North River has here an elevation above tide-water of over 800 feet. The bottom lands are not subject to overflow to any great extent. The plateau lands are from 100 to 300 feet above the rivers; the foot-hills from 200 to 400 feet; the outstanding

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*** This report cannot be intelligently followed without frequent reference to the map.**

peaks and the mountain crest rise to the height of from 1,000 to 1,200 feet above the river, or about 2,000 above tide-water.

The front lands mostly have gentle slopes, whilst the mountain peaks and backbone ridge, with their connecting saddles, have precipitous sides, with deep ravines between. Much of the surface is strewed with blocks of hard sandstone, but there are large areas, not only near the rivers, but on the hills and plateaux, which are smooth and suitable for cultivation.

The cultivated lands amount to about 2,500 acres, and are largely river bottom, with some adjoining hills. They have long had a high reputation for fertility. Most of the lands of Green Forest and Hart's Bottom, amounting to over 1,000 acres, have now been laid off into streets and building lots. They lie on the North River front. The old Buena Vista farm is on South River, around the old furnace, and is three and a half miles distant from the town site. It has on it a handsome mansion, a mill and other improvements, and is a beautiful estate in itself.

But the great body of the Buena Vista territory is covered with second growth forest, of twenty-five years' standing and upwards, the most of the original growth having been coaled off for the old furnace. Considerable areas, however, are still in virgin forest. Here lie the iron ores and other minerals. All these points will be enlarged upon hereafter.

The drainage is chiefly into North River, but on the upper end there are two leading valleys which discharge into South River. That part of the land which lies west of South River, extends to the top of Timber Ridge, an elevation above the river of 300 to 400 feet along its highest line. Its drainage all enters South River, largely through the valley of Marl Run. The land which lies on the Blue Ridge mountain reaches nearly to the bed of Irish Creek, which is a constant mill stream. White's Run is said to have a constant flow at all seasons, and so of Marl Run. But most of the small mountain streams are irregular in their flow, often disappearing in the summer. They all have a great fall. South and North Rivers have a good volume of water at all seasons.

This great body of land is singularly accessible, and all its products may be brought to Buena Vista City by down grades. Three wagon roads through the property cross the Blue Ridge into Amherst County, whilst other roads, public and private, run conveniently in various directions.

The Richmond and Alleghany Railroad, now a part of the Chesapeake and Ohio system, and the Shenandoah Valley Railroad parallel each other closely through the site of Buena Vista City, and along the east bank of North River, from a little below Loch Laird Station to a little above Green Forest, a distance of about one and a half miles. Near the latter station the Shenandoah Valley Railroad curves northeast into the valley of the South River, passing near the western edge of the Buena Vista territory for its whole length, and running for one mile through it near the old furnace; thus offering transportation facilities to every part of the property. Besides these two railroads, the Lexington branch of the old James River Canal, now used for the distribution of water-power, runs along the bank of the North River, close to the railroads.

There are two grist-mills and a number of dwelling-houses and other buildings, large and small, scattered over the property, besides the handsome new hotel and other structures which have been recently erected. So much for topography.

GENERAL LOCATION.

Buena Vista is in the Great Valley which extends from Canada to Alabama, and which is noted for its limestone lands, iron-beds, clear streams, healthful climate, picturesque scenery, the number of its towns, and its substantial population. The valley is known in Pennsylvania as the Lehigh, Cumberland, etc., where it abounds in natural resources and acquired wealth. In Northern Virginia it is the Shenandoah Valley. In the middle it originates the James and the Roanoke rivers. Southward it is known as Southwest Virginia, where now is to be witnessed a remarkable scene of industrial development. Through Tennessee, North Georgia, and into Alabama the Great Valley continues, and is marked everywhere by the same characteristics. It is in this Great Valley, and surrounded by the advantages belonging to it, we find the Buena Vista property.

GEOLOGY.

Blue Ridge ge
erally, not
ways dividi
line betwe
Archæan a
Silurian.

The crest line of the Blue Ridge Mountain has commonly been regarded as the dividing line between the Archæan Rocks on the east and the Silurian on the west. This is not strictly true, as has been shown in Pennsylvania and Northern Virginia, and as has been recently discovered by Prof. Harry D. Campbell in reference to this region. Prof. Campbell found the Potsdam rocks east of the Blue Ridge in Amherst and Nelson Counties, showing that these great sandstone and slate strata once arched high over the Blue Ridge, but were fractured and wasted along the crest line. Such cases, however, appear to be exceptional and to indicate bays and estuaries along the coast line of the Archæan continent. For our present purpose, the crest line of the Blue Ridge may be taken in a general way as the line which separates the granitic, feldspathic and micaceous rocks of East Virginia from the sandstones, argillites and limestones of the Great Valley; and this statement will apply to the ridge from the Delaware River to the Coosa. This dividing line is known as South Mountain in Pennsylvania and Maryland, Blue Ridge in Virginia to the bifurcation in Floyd County; and thence southward by various names. In Virginia, excepting three river gaps, the mountain is not only continuous, which it is not in Pennsylvania, but it is much higher and larger in every way than it is north of the Potomac, whilst its geology

Blue Ridge
larger in Vir-
ginia than i
Pennsylvan

remains substantially the same. This fact, as will be remarked upon hereafter, has an important bearing upon the relative quantity of ores and other minerals to be found there and here.

chæan not isible on uena Vista rritory.

e rock strata.

The Archæan rocks nowhere, so far as I have seen, show themselves on the Buena Vista property as they do on the west side of the crest on the head waters of Irish Creek. The rocks here all belong to the two lower divisions of the Silurian age, *i. e.*, to Nos. I. and II., according to the notation established by the Rogers brothers in Virginia and Pennsylvania. The most of the territory is made up of the rocks of No. I., the bottom group of the Silurian rocks, called variously Primordial, Cambrian, and Potsdam Sandstone group. I will use chiefly the last-mentioned name as the one most generally known. These are the great rocks which stand against the mountain and constitute a large part of its bulk. They consist of heavy ledges of whitish quartzite, or altered sandstone, alternating with beds of clay slate, or shales, as they are sometimes called, owing to the readiness with which they decompose when exposed to the weather. These slates are sometimes spoken of as argillites, from the large proportion of clay in their composition. They were formerly regarded as talcose slates, owing to their unctuous or soapstone feel. But Prof. Dana seems to have proved that they are largely made up of decomposed mica, some remains of which are occasionally visible in both the slates and sandstones. Hence they are now called by the best geologists damourite or hydromica slates. Their prevailing color is an ochreous yellow, which, when deprived of its iron coloring, becomes white. There are also layers of red slate, generally thin, and, like the white, closely associated with iron ore beds. As these slates are the great repositories of the ore beds, much will be said of them hereafter. They begin at the bottom of the series, close to the backbone of the main mountain, and, alternating with the sandstones, they lie on the top of all in a heavy bed.

The great s
stone beds.

The great sandstone ledges command the attention of every observer. At Balcony Falls they are prominent on both sides of the James River, and in every gorge of the mountain they show themselves in like manner, standing with a high dip to the N. W. There are three great beds and numerous smaller ones. All these, with their intercalated beds of slate, when first lifted up from the sea bottom, stood up in continuous parallel layers; but were subsequently gapped and ploughed across the strata into the deep ravines we now see at short intervals along the mountain side. The water behind had to have outlets, and the indications are abundant to show that probably owing to extraordinary accumulations of snow and ice, melted finally by warm rains and a hot atmosphere, such water floods came down all our valleys, large and small, as has never been known within the historic period of man's existence. To these gaps in the sandstones we owe the peaks and "hog-backs," which stand out so impressively in the front line of sandstone, and to the scouring and rushing of waters out of the heart of the mountain do we owe the "saddles" and spurs which run out from the backbone of the main mountain.

The total thickness of the Potsdam group (supposing no reduplications) exceeds 2,000 feet on the Buena Vista lands. In Pennsylvania its maximum thickness is 1,000 feet, and in many places there it thins out to nothing.

The formation in this part of Virginia is thicker than it is anywhere north, and thicker than in S. W. Virginia. This suggests that here was probably a deep bay, somewhat sheltered from ocean currents, and receiving sediments from large and long rivers, flowing from highlands on the east.

DETAILS OF THE POTSDAM GROUP.

(REFER TO THE CROSS SECTION.)

tom of Pots-
m Group.

The contents of the Potsdam group on the Buena Vista territory are best studied along the "saddles" which connect the main mountain with the front line of peaks and ridges, and along the spurs which project from the front faces of these peaks and ridges. Beginning at the crest of the main mountain we here find fine-grained, soft, purple and whitish feldspathic sandstones, slates and conglomerates, looking as if they had been somewhat changed by heat. As to whether these rocks form the bottom of the Potsdam or the top of the Archæan, geologists differ. I prefer to class them with the Potsdam. The trend or strike of the strata varies from north to northeast. They dip to the northwest at an angle with the horizon of about 35°. These crest rocks are some hundreds of feet thick. They soften outwards, and when they join the next overlying strata along the back of the spur or "saddle," there is a sag or depression, beyond which is a swell caused by harder sandstone strata, whose edges may generally be seen exposed on the tops of the swells. This state of things may be conveniently seen where the two roads across White's Gap meet near the top of the mountain, and still better at the

Iron Ore Bed No. 1.

corresponding point on the Robinson's Gap road. This swell is but little lower than the crest of the main mountain. This harder sandstone which crops out on the swell is also feldspathic and fine-grained. Structure flaggy, color dirty white. It is specially interesting as the matrix in which we find small beds of iron ore. It is the *black oxide* apparently, but owing perhaps to its admixture with sand it does not here affect the magnetic needle, as it is reported to do elsewhere. The only place I saw this was on the Robinson Gap road. This is spoken of as the magnetic lead.

West of this ferriferous sandstone and geologically overlying it, comes another lot of feldspathic sandstones and slates, more decomposed than those closer to the axis of the mountain; which might be called kaolin shales. It is from the decomposition of such rocks as these come the kaolin beds, which supply the china-ware potteries and fire-clays.

Ore Bed No.

Next to the kaolin shales comes a group of hard whitish sandstones of flaggy structure, in which there is a bed of conglomerate containing small white quartz pebbles. Near the bottom of this group of sandstones is the place of the *red hematite*, often called the *block ore*, which is regularly stratified in one bed or many, and of varied thickness and quality. Where I saw it in places on the Robinson's Gap road, there were a number of thin siliceous beds; the thickest may reach three feet in some places. More will be said of all these ore beds hereafter.

Next to these sandstones comes a heavy bed of variegated, yellow, red and whitish, decomposing slate, several hundred feet thick, near the base of which is a ferriferous bed, which, on the Jordan road to White's Gap, re Bed No. 3. yields a smooth, heavy *shale ore*, but which on the Robinson Gap road gives merely a solid ferriferous clay.

Overlying this bed of argillite, or damourite, as it should probably be called, comes one of the massive beds of gray quartzite, at the outcrop of which on the "saddle," there is a swell with a sag on each side of it. This sandstone in rare cases shows the pipes of the *scolithus linearis*, the characteristic fossil of the Potsdam Sandstone. Its thickness is two or three hundred feet. Over this lie alternating beds of slate and sandstones in comparatively thin layers, until we reach the great quartzite bed of near 300 feet in thickness, which forms the body of the front line of peaks and ridges, and whose bold edges, rising high on either hand, form the portal to each of the great ravines which penetrate the mountain. Owing to its jointed structure and its friability under atmospheric influences, it has discharged from its surface everywhere an amazing talus which rip-raps the mountain side for hundreds of feet in length and width. We commonly call this the *scolithus* sandstone, because in its upper layers the burrows of this "early worm" abound.

Underneath this sandstone, or in its bottom layer, lies
re Bed No. 4. *a great bed of iron ore*, which is often rich and good in the middle, and shales off leaner and more silicious into the enclosing walls. The bed as a whole is sometimes 30 to 40 feet thick, with 3 to 6 feet of workable ore in the middle. I have not seen much of this ore, but I suspect that it occurs in this sandstone as the iron ore of Low Moor and Longdale does in the Oriskany sandstone in long, irregular beds, sometimes merging into the sandstone, and sometimes perhaps cut off entirely. It is an interesting bed, of which more will be said hereafter.

The front sp

Passing now to the front of these outer peaks and ridges, we will observe the spurs that project out into the valley. These spurs are narrow or wide according to the width of the mountain from which they project; or, more strictly, according to the distance between the mountain gorges whose waters have in the main determined the width and form of the spurs with modifications caused by river floods, and by local springs, frost and rains. These spurs in some places have been shortened by the rivers; an interesting example of which is to be seen from the front of the Buena Vista hotel, where almost the whole of the spur in front of Robinson's Ridge has been cut off by North River, probably by the great floods which occurred near the close of the Quaternary period. But we need not regret this washout, as it gave us the beautiful plain of Hart's Bottom and Green Forest. The same floods gave us the fine hotel site, which is simply a terrace cut on the point of Mineral Ridge.

Mineral Ri
bent by th
Barclay Be

It will be noted that Mineral Ridge is a spur bent around to the southward. This bend is to be accounted for by the superior hardness of the Barclay iron ore bed at its south end. The same cause affected the course of both branches of Chalk Mine Run and determined the shape of the Hayes Ridge. Where the spurs are unusually wide, as is the case between the two branches of Chalk Mine Run, the natural drainage has made shallow subordinate valleys, which to that extent have disturbed the plateau character of the spurs. Still on the different spurs and ridges there are thousands of acres of plateau land which lie at a gentle inclination.

The height of these spurs generally varies according to their width—the wider they are the higher they rise

A sag.

ace of the 'hite archi- ectural sand- one.

on the mountain side and the steeper their sides. Where they join the mountain their elevation is from three to five hundred feet, and at this point there is usually a sag ten to thirty feet deep and twenty to seventy-five yards wide, occasioned by the softness of the underlying material, which is partly slate and partly soft sandstone. The swell west of the sag is lumbered with blocks loosened from the underlying sandstone ledges, whose outcrop is thus concealed. This sandstone bed has the same dip with the great quartzite bed of the mountain, viz., about 35° to the N. W. The bed is composed of two parts, a softer lying beneath a harder. The softer is a beautiful white sandstone, which makes a good building stone, and when decomposed falls into a glass sand. This will be mentioned again. This sandstone bed I have never seen fully displayed, but I suspect that it is less than 100 feet in thickness, including both lower and upper divisions.

) ledges of ındstone in ·ont of this.

We have now done with the sandstones of the Potsdam group. The accumulation of sandstone boulders which we see far down the spurs and on ridges cut off by valleys from the mountain, such as Hayes Ridge, where these blocks are found sometimes rounded on the very top of the ridge 100 to 200 ft. above Chalk Mine Run, might readily deceive an experienced geologist into the belief that there were ribs of sandstone to the west of the ledges above described, but after long study I am satisfied that no such ribs exist, and that all the sandstone debris seen west of the front line of peaks on the high hills, as well as in the hollows, were floated down from the mountains in the rear.

THE DAMOURITE SLATES.

The ore bearin slates.

The moving and bending o the slates.

All in front of the mountain sandstone, until we reach the great limestone formation nearly a mile off, is Damourite slate, holding iron and manganese ores, with the exception of a narrow line of limestone, which will be fully described presently. This is the formation which has made the west foot of the Blue Ridge famous from Easton to Anniston. These slates lie on top of the sandstone, and have a thickness of 300 to 400 feet. As seen on these mountain spurs and outlying ridges, they are tilted, folded and crumpled over most of the area. On the spurs the slates lie with more regularity next to the sandstones than at a distance from them. The flexed, twisted and sometimes mixed condition of the slates has been caused partly by the pressure of the rising sandstone in the rear against the hard limestones in front, but chiefly, I suspect, by the slipping down of the slates along the face of the sandstones, and massing near the base. The higher the angle of the sandstones rises, the more would the slipping naturally be. At Buena Vista we may have slates now lying at the foot of the mountain, which originally reached to the top of the front line of peaks. and the peaks themselves were once far higher than they are now. At some places along the mountain, where the dip is gentler, as it is north of Irish Creek, the slates rise higher on the sandstones; in some places covering them even to the tops of the ridges. Owing to the channeling out of the slates by the local streams, assisted by frost and the heavy currents of the rivers, which sweep along the foot of the mountain, these iron-bearing slates have been greatly wasted, and in some places almost entirely removed from off the front of the sandstones; hence it is that in some properties they are either wanting entirely or have been so displaced and thinned as to exhibit no ore.

he favorable condition of he slates at Buena Vista.

But in the case of Buena Vista there is a most remarkable and highly favorable condition of affairs. South River, which washes the front of the Blue Ridge for fifteen or twenty miles, and in many cases has carried off large slices from the iron-bearing slates, sheers off from the mountain when it reaches the neighborhood of Irish Creek, cuts its channel in the outlying limestones, and leaves a fortification of hard rocks between the stream and the ore-bearing slates for the rest of its course. Owing to this deflection of the river, there has been preserved on the Buena Vista property an extraordinary, indeed, so far as I know, a wholly singular and unexampled area of ore-bearing slates lying between the mountain and the limestone group. The ore-bearing area of slates, on the old Buena Vista property alone, has a width of over three-quarters of a mile, and a length of about four miles, omitting what is to be found on the Green Forest and Hart's Bottom additions, where there is a length of two miles more, with a breadth varying from one-fourth of a mile to near half a mile. This southern prolongation undoubtedly holds both iron and manganese ore, but it has not been prospected enough to allow an opinion as to their number and extent. There is also ore beneath the alluvium of the river bottom.

he numerous flexures.

The slates on the old Buena Vista property have their richness greatly increased by the numerous parallel folds into which it has settled. These folds are the chief repositories of the iron ore. The exact depth of the folds has never been ascertained. The leading ones certainly extend below the beds of the streams, but how far below we have no means of determining. The Colonial bed has been penetrated by shafts to a depth of nearly 100 feet below the bed of Chalk Mine Run (at the Water Hole), but no bottom was reached, and from all the testimony of those who have worked the mines, none of the leading ore beds has been penetrated to the bottom. There are of course irregularities in the direction and in the condition of the folds or rolls in the slates, but their typical structure, from the sandstone to the limestone, seems to be a succession of closed folds, forming synclines and anticlines, having a general parallelism to the mountain rocks on one side, and the limestone rocks on the other. This I fully proved by following the outcropping of the ore beds with my compass, and also by the uniform relation of the ore beds to a certain narrow line of limestone which runs in the trough of the slates the whole length of the property. As this bed of limestone is interesting and useful as a guide, both geologically and economically, I will here describe it.

THE MIDDLE LIMESTONE.

Those who have observed the condition of things at Balcony Falls, are aware that there is an outlying ridge something less than a mile to the west of the main mountain, known as Salling's Mountain, whose axis on its southern prolongation crosses James River near Glenwood Station. Between this outlier and the main mountain lie Arnold's Valley on the south of James River, the flat lands in the fork of the rivers, and the valley in the Baldwin and Mathews neighborhood. This valley is an open fold, or syncline, in which is held the bottom limestones of the No. II. series. The Salling Mountain axis northward crosses the North River belo Miller's, and gradually approaches the main mountai until finally the open syncline becomes a closed fold, an is thus seen on the spur which projects toward the river the lower end of Hart's Bottom. By this time the Po dam Sandstone arch, which forms the body of Sallin Mountain, sinks below the level of the country, and prolongation of the syncline northward is seen only in overlying slates, which, in closing, caught and held their central trough some of the bottom layers of th overlying limestone, though much less than is found i the wider part of the syncline. These limestone layers are doubled up on themselves, thus forming a solid mass about two hundred feet across the top, and dipping with the slate to an unknown depth. I saw this bed of limestone pretty well exposed in three places—namely, where it is broken across by Little Chalk Mine Run, by Big Chalk Mine Run, and by Stony Run. I saw also its float in a cross hollow a quarter of a mile beyond Stony Run, and it has been dug up in the bottom south of Mineral Ridge. I have no doubt it extends the whole length of the Buena Vista territory. It is an irregular line which changes its course four times at least, determined no doubt by variations in the course of the underlying sandstone. These variations go from N. 45 E. to N. 16 E. Its distance from the nearest sandstone is about 600 feet, measured on top of Mineral Ridge, but it seems to get farther away from the mountain as it goes northward. The dip flattens toward the north end. At the exposure on Little Chalk Mine Run, its dip is about 40° N. W.; at Big Chalk Mine Run it is 20° to 25° N.

W., and at Stony Run it is about 5° N. W. The importance of these details will be seen when we come to the consideration of the ore beds. As will be seen on the map, I took the limestone as a base line, to which I refer all the ore leads in the front slates. This line and some cross lines were run under my direction by Mr. John Carmichael. The limestone itself is of no value, being so silicious as scarcely to deserve the name.

ORIGIN OF THE IRON ORES.

The only material difference of opinion among geologists as to the origin of the ores found in the slates, is as to whether they were originally deposited from solution in separate beds on the surface of the slates whilst they still lay undisturbed on the bottom of the Potsdam ocean, or whether they were diffused chemically or mechanically through the mass of slaty material like other elements, and subsequently gathered into beds after the sea bottom was lifted into the air. According to the latter view, which is more common, this aggregation of the particles of iron oxide was made possible by the decomposition of the whole body of slates. The slates originally contained large proportions of lime, potash and soda, all of which are soluble in acidulated waters. As these elements were leached out and the slates gradually converted into clay, it is thought that the iron was dissolved out by the same waters, and redeposited in beds or pockets when reaching some impervious layers or basins of clay. Neither this theory of the genesis of the ores, nor any other that I have seen, reconciles all the facts; but I need not here dwell upon

This general statement will be concluded by remarks on

THE LIMESTONE GROUP: No. II.

This is the next group in the series of overlying r It does not include all the Valley limestones, but the lower half, which reaches to the top of the Cl subdivision, the decomposition of whose chert strews certain well-known ridges with "gravel." No. II. division (Canadian of Dana, etc.) was estim by Prof. John L. Campbell at 1,400 feet in thicknes Rockbridge County. His studies led him to recog and accept the New York subdivisions, and to esti their thickness as follows: (Read upward.)

Subdivisions of No. II.

3. Chazy	300 feet
2. Quebec	450 "
1. Calciferous	650 "
Total	1400 "

Calciferous.

1. The name Calciferous is applied to the lower division, because it is composed largely of calcar sand-rocks and slates; in it, however, are strata of l stone more or less silicious and magnesian, among w we find the hydraulic limestones, which have l worked into cement for more than forty years by Messrs. Locher at Balcony Falls.

Quebec.

2. The Quebec (Levis of Rogers, Knox Dolomit Tenn.) subdivision is in large part a dolomitic or nesian limestone with hydraulic strata. These are

Limestone ores.

ferriferous limestones, whose decomposition has o sioned those fine beds of heavy brown ore which largely worked and specially valued in the Lehigh and Cumberland Valleys, in South-west Virginia, and in the States farther south. These ores generally are high in iron and low in phosphorus and silica, and in South-west Virginia some of them are suitable for making Bessemer pig. But whilst along the whole line the Quebec dolomites hold more or less iron in their composition, the proportion of iron varies greatly, and workable beds of ore are exceptional. It is common, however, for the dolomite clay to be so liberally charged with particles of ore as to make it profitable to wash the clay where washing facilities are good, in places where there is no lump ore.

Chazy, maki the gravel ridges.

3. The Chazy subdivision (the upper) is composed chiefly of a light blue, impure limestone, through the body of which are scattered small blocks of chert (an impure form of quartz), which, being much more durable than the enclosing limestone, are found strewing the gravel ridges long after the limestone has disappeared. But besides these scattered blocks in the limestone, there are ledges or strata of chert several feet in thickness, and also one or more thin strata of yellowish, gritty and rather soft sandstone intercalated among the Chazy limestones—the chert near the top and the sandstone near the bottom of the group. Workable beds of iron ore are in rare cases found in the Chazy, and small pockets are common. Timber Ridge is crested with the lower or sandstone subdivision of the Chazy, whilst the Brushy Hills give prominence to the upper or cherty part. These two ridges come together in the lower part of Rockbridge County. The cherty rocks are occasionally seen on Timber Ridge.

Iron ore in t Chazy.

Timber Ridg

Brushy Hills

THE LIMESTONE GROUP NO. II. ON BUENA VISTA.

The bottom of this group is characterized by heavy beds of slate, which merge into the top slate beds of the Potsdam Group so imperceptibly that it is extremely difficult, if not impossible, to determine the exact line of junction. Both of the slate groups may be seen side by side on Chalk Mine Run and along the road behind Capt. Jordan's buildings, between which point and North River they both cross the creek diagonally. The No. II. slates are harder than those of the Potsdam, and it will be near the truth to say that the heavy bed of red, or rather, purple slate, which crops out so boldly above the school-house, and which has been quarried, and the thinner bed of greenish slate underlying it, constitute the bottom beds of No. II. The slate beds of this group are at this place very heavy, for they, with some bands of limestone and calciferous sand-rock, make up the body of the three hills which stand in front of the Green Forest depot; though it is possible there may be a fold here which increases the apparent thickness of the slate beds.

he hills in ront of Green Forest Depot.

The main road from Green Forest to the old Buena Vista Furnace runs all the way on the calciferous and Quebec divisions of the No. II. group, and after crossing South River at the furnace, the road toward Lexington climbs Timber Ridge, which here contains the entire Chazy division, though by reason of inversion the chert shows on the east side, and the sandstone subdivision on the west.

otel Buena Vista nearly n the line of unction.

The line of junction between No. I. and No. II. has a general parallelism with the Blue Ridge mountain. The Buena Vista hotel stands nearly on this line; thence crossing the creek behind Capt. Jordan's house, it passes west of Hays Ridge, crosses the Amherst road a few hundred yards east of the fork where the road turns into the Long Hollow, and passes by the old Camper house, being there off our territory.

The rock strata, though not without rolls, generally stand at a high angle, dipping N. W.; sometimes vertical. The Quebec limestones and slates lie in the hills on both sides of South River, but chiefly on the east side. The bands of deep red earth indicate the place of the iron-bearing strata; and an attentive observation will generally show bits of brown ore scattered on the surface, with an occasional lump of larger size. This ore and its clay have been left by the decomposed limestone, whose outcrop could be reached by digging. The decomposition, however, has extended deeply in some places, possibly some hundreds of feet.

Place of the o

I saw a little ore also in the Chazy division, near the east base of the Timber Ridge. It is near the upper side of the Buena Vista property, not far from a new schoolhouse. And I saw more of the same, and also dolomite ore, on the same ridge, near to North River, on part of the Hamilton land, now owned by Capt. Jordan. The ore prospect on this division will be discussed hereafter.

RECENT FORMATIONS.

Diluvium.

I have already alluded to the ravages of great floods of comparatively modern times—floods which gapped our mountains, formed plateaux, terraces and bottoms along our streams, and strewed them with foreign clay, sand, gravel, rounded boulders and angular blocks. Hills over

100 feet above our present river beds are often found to be top-dressed with this drift, sometimes to the depth of ten feet or more. These deposits in our section of the country have received but little attention from geologists, who have (as I think erroneously) concluded that no traces of the glacial or post-glacial floods are to be found south of the Potomac River. It is possible that this transported material may belong to the mesozoic period, though usually referred to the quaternary.

Diluvium on Buena Vista.

This drift material is found abundantly on the Buena Vista lands, and not only on the hills and lowlands bordering the main valleys of South and North Rivers, but also in the creek valleys which come out of the Blue Ridge mountain; showing that probably there were great accumulations of snow and ice on this mountain, which, by sudden heat and warm rains, were rapidly melted. Much of the sculpture which gives such picturesque beauty to the Buena Vista scenery is the result of the water-currents of that period. We are indebted to this cause even for the beautiful plateau on which the Hotel stands.

Marl.

The marl of this region is a tufaceous deposit from calcareous waters. An unusual number of the small streams flowing out of the east side of Timber Ridge have made heavy deposits of marl of great purity along the banks and bottoms. The deposit on Marl Run, opposite to the old furnace, extends a fourth of a mile along the creek; it is in places 100 feet wide and 30 feet deep. This marl was used in the old furnace; and is almost pure carbonate of lime. It is, of course, a recent deposit, and

The marl bed on Marl Run.

no doubt it is still growing, though with less rapidity than in former times, when the heavy vegetable growth on Timber Ridge supplied more acid to the rain-water, which descended into the earth and dissolved the limestones.

GEOLOGICAL SUMMARY.

(A CONDENSED STATEMENT OF WHAT PRECEDES.)

An epitome fo the ungeological.

Geologically the lands at Buena Vista belong to the Lower Silurian age, and are included in the No. I. and No. II. of the Pennsylvania and Virginia classification. No. I. has many names among geologists. It is called Primordial, Cambrian, Potsdam, etc. The formation here is about 2,000 feet thick, and is composed of slates weathering into clays, alternating with heavy beds of sandstone. This is the bottom group of the fossiliferous rocks, and lies upon the granites, mica slates, and feldspars of the Archæan age, whose rocks make up East Virginia almost exclusively from the crest of the Blue Ridge to tide-water. These Potsdam rocks are well exposed at Balcony Falls, and may be seen in all the gorges on the west side of the Blue Ridge. On the Buena Vista property these rocks extend from the backbone of the Blue Ridge to a line which might be drawn from the dwelling-house on Enderly through the Hotel Buena Vista, crossing the creek behind Capt. Jordan's house, passing at the west foot of the Hays Ridge until it leaves the Buena Vista lands near the old Camper dwelling-house.

Potsdam on Buena Vista.

We will now look for a moment at the *contents* of this Potsdam series. Beginning with the crest of the Blue he four inter-sandstone beds

Ridge, and moving westward along any of the roads which cross the mountain, we would find that all the rocks stand at a high angle and dip north-west, having been tilted up by the rising of the axis of the Blue Ridge. Four beds of iron ore will be passed before getting out of the gorge of the mountain. These are not the beds which are usually mined for furnace ore, although some of them have been resorted to, and will be valued in the future. Passing out from the mountain, we find in front of each peak a long, and sometimes wide, projecting spur (of which Mineral Ridge is an example). These spurs are composed of the slate which forms the top bed of the Potsdam series, and is the chief depository of the iron ore beds. This slate bed is only about 400 feet thick, and yet it has been so crumpled and denuded that it shows a surface fully three-quarters of a mile in width, and extending from Mineral Ridge to White's Run, a distance of about four miles ; not t speak of its southern prolongation through Hart's Bottom In this belt runs a narrow line of limestone, which belong geologically to the next higher group of rocks, but in th process of folding and crumpling this strip of limesto was caught and held in one of the folds of the unde lying slate.

he ore beds in the slates.

The numerous ore beds which lie in the folds of t slate will be particularly described hereafter.

West of the boundary line of the Potsdam slates t observer will find other slates harder and somewh differently colored, and beyond these silicious, hydrau and dolomitic limestones, which constitute the gro No. II. It also has different names in the geologi such as Canadian, Knox, etc., and is subdivided i

The place o limestone

Calciferous, Quebec and Chazy. This group also is productive of iron ores. In southwest Virginia their best ores come from this Canadian group.

These rocks occupy all the Buena Vista territory west of the line of division above named.

Diluvium.

Besides these ancient deposits there are transported earths, gravel and boulders, which form the bottom lands and top-dress of many of the hills. Probably these were deposited at the close of the Glacial epoch.

Marl.

There is also an interesting deposit of marl still more recent, found on Marl Run, which enters South River from the Timber Ridge side opposite to the old Buena Vista furnace. It is a calcareous tufa, formerly used for flux at the furnace.

RESOURCES OF BUENA VISTA.

I will now report systematically on the economical features of the Buena Vista estate in the following order:

1.—MINERALS—TO WIT:
    a.—Iron Ore.
    b.—Manganese.
    c.—Clays, Ochres, Umber and Sand.
    d.—Building Stones.
    e.—Hydraulic Cement Rocks, Limestones, Marl and Lime.
2.—FORESTS.

3.—WATER AND WATER POWER.
4.—AGRICULTURAL LANDS.
5.—MISCELLANEOUS.
  a.—Climate.
  b.—Scenery.
  c.—Neighboring Objects of Interest.
  d.—A Good Point for Scientists.

(a.) IRON ORES.

The large deposits of iron ore command special attention. I studied their geological relations, their surface indications, the character of the beds themselves, so far as they could be seen, and their analyses, made from samples selected by myself and others in whom I have confidence. I also took what testimony I could get from those who had worked in the mines now "fallen shut." Unfortunately I could not get a sight of the great Colonial bed, which was formerly the main dependence for furnace ore, and which by all testimony is the richest and largest of all the beds. But we have the best testimony concerning its character, not only from those who worked it, but from the most competent and disinterested observers, who examined it whilst it was being mined.

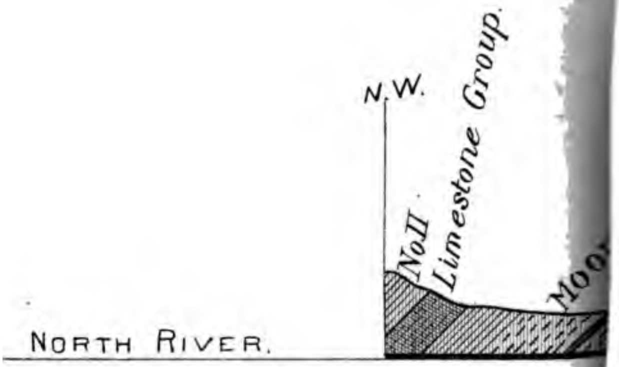
The outcrops of all the beds have a general, though not exact, parallelism with each other and with the sandstones on one side and the limestones on the other. There are, however, irregularities in each bed, and the courses vary from N. 17 E. to N. 45 E. They have a general N. W. dip at about the angle of the sandstones, viz. 35°.

e beds named

The ore beds are numerous, and I have given them names rather than numbers, as being more convenient in

Vertical

Beginn



Scale

■ Red

■ Yello

▨ Li

▨ Sa

▥ Ul

▨ Ul

▨ Granite

beds nam

case hereafter beds should be added or subtracted. The last name in the list is meant to include all the limestone ores. The most of these beds continue, I think, the whole length of the property from Enderly to White's Run. After giving the list I will take them up one by one, and tell all that I know and think about each. The list begins with the bed nearest to the backbone of the Blue Ridge mountain, and continues regularly outward to the valley of South River.

LIST OF IRON ORE BEDS.

(1.) Anderson.
(2.) Moorman.
(3.) Shale.
(4.) Patrick.
(5.) Glasgow.
(6.) Jordan (Captain).
(7.) Leake.
(8.) McCorkle ("Lawyer Tom").
(9.) Miller.
(10.) Barclay.
(11.) Colonial (or Hays).
(12.) Moomaw.
(13.) Limestone Ores.

These beds are all indicated on the map and on the geological cross section, to which the reader is referred. The first four beds are those heretofore mentioned as occurring among the great sandstones, and have not been regarded hitherto by the owners of Buena Vista as

The four inte
sandstone bed

ie upper eight

possessing any value. Two of them, however, ha been worked elsewhere, possibly all of them. All th rest, except the limestone ores, lie in the upper Potsda slates, and six out of the eight give signs of their presence on Mineral Ridge; four of them are there uncovered. Let us now take them *seriatim.*

(1.) THE ANDERSON BED.

This bed is named in honor of the treasurer of Buen Vista Company.

Each director and also a well-known non-official stockholder (Mr. Leake) has a bed named for him. But course there was no effort to discriminate in respect the quality of the beds whilst naming them.

ie Anderson ed.

(1.) The Anderson bed is the sandy block ore lyi in the first knoll west of the crest of the main mountai It is called by some persons the magnetic bed, and is sa to attract the needle strongly where it has been se elsewhere. Here it does not attract the needle, but h the appearance of a true black oxide. The bed is fro two to three feet thick, though not of uniform grade, a shades gradually into the sandstone. It does not see valuable where I observed it, and yet, as with other or it may be workable at points not far away.

(2.) THE MOORMAN BED.

d Ore.

This is the Red Hematite, or block ore, sometim called specular. It is persistent along the mountain and sometimes very thick, but it is rarely workable, owing an excess of silica. A few years ago it was shipped fro the Arcadia property, near Buchanan, to be used in the Quinnemont furnace, in connection with other ores, and it may have been used for mixture on other properties. It usually has the advantage of being very low in phosphorus. On the Buena Vista property, where I saw it, it is too lean and silicious for furnace use.

(3.) SHALE BED.

The Shale B
not always o

I know nothing of this bed more than has heretofore been stated. Where exposed on the Hart's Botton road, it is simply a ferriferous shale; but on the Jordan road to White's Gap it certainly contains a fine quality of yellow and dark brown ore, almost free from silica and well suited for mixing with silicious ores. The float along the road is found mixed in a heavy sheet of sandstone debris, so that I was unable to get any glimpse of the ore in that place. So far as I could learn, no one had ever prospected for this ore, but it certainly deserves attention.

(4.) THE PATRICK BED.

The phospho
ore.

Ores will be d
phosphorize

This is the great bed of dark brown ore which lies near the base of the *scolithus* sandstone. It has been ignored heretofore on account of its phosphorus, but it is a highly-interesting bed and will be highly valued when the time comes, not long hence, when iron ores can be dephosphorized economically. I have not seen much of this bed, and therefore cannot describe it exhaustively. It seems to lie in walls of sandstone, but so near to the underlying slate that I suspect that the slate sometimes forms the foot wall. Generally, however, it may be regarded as an inter-sandstone bed, with a middle of three to six feet of compact, smooth ore of great spespecific gravity, shading outwards into the body of the sandstone, and passing gradually into a lean sandy ore and finally into a ferruginous sandstone. In Robinson's Hollow it seemed to have a total thickness of about thirty feet.

e great out-
rop on Chim-
ey Rock
lountain.

anganese also

The appearance of the bed along the Jordan road to White's Gap, leads me to suspect that like the Oriskany and other sandstone ores, it is sometimes cut off or thinned out, and that tongues of sandstone may be found in the body of the ore bed. On the top of Chimney Rock mountain there is a great outcrop which forms a comb on the north end of the mountain, having taken the place of the scolithus sandstone, which had moved westward and been wasted on the outcrop until it was some distance down the mountain side. Thus all the strata in that mountain cross it in diagonal lines. The outcrop of the ore bed has gradually climbed up from behind the mountain to the crest where its harder and more silicious ribs show prominently and indicate great thickness, whilst the debris shows that in the bed there is what to the eye seems to be a fine quality of ore. Intermingled with the float of this bed are blocks of pyrolusite or oxide of manganese of fine quality. I failed to take a sample from this place, which I regret, but the bed should be opened entirely across in order to give us an average sample of the workable ore. I think that the phosphorus in this bed is generally from 1 to 2 per cent. When not more than this, it could be worked with ore low in phosphorus, but there are at least bands and patches in which the phosphorus rises to 12 per cent. It is then simply a phosphate of iron, and I have seen samples of true dufrenite taken from this bed. Phosphoric acid has so much value as a fertilizer that in the future this bi-product might pay for purifying the ore.

Dufrenite, or phosphate o iron.

A future sou of phosphor acid.

This bed has been opened on the Vesuvius property, where McCreath took a sample, which gave the following result:

Vesuvius Ore

Metallic Iron	52.425
Manganese	.302
Silica	8.050
Sulphur	.005
Phosphorus	1.466
Phosphorus in 100 parts iron	2.796

These first four beds might be grouped together under the name of inter-sandstone beds. They all lie in sheets inter-leaved with the sandstones and slates, and presenting thin edges, though generally covered, in every mountain gorge. They could be easily mined and loaded.

Easily mined

THE UPPER DAMOURITE SLATE BEDS.

The next eight ore beds belong to the upper slates of the Potsdam series, but before considering them severally, I will make some remarks about the slates and their ore beds which apply to all. These beds are not all independent and continuous, like the inter-sandstone beds. They lie in folds of the slate beds and are repeti-

Ore beds in t folds of the slates.

t least two eparate beds.

tions chiefly. It is generally thought that there is but one bed, and elsewhere this may be true as a rule, but I think that here there are two beds certainly, and perhaps three, whose folds form the eight beds of this group. I shall not undertake to connect all of the outcrops of the different beds, for want of the requisite data. My view as to the number and connection of the beds can be seen on the vertical cross section.

e beds in hese slates ıay be expect-d to improve ı quality ownward, nd to accu-ıulate at the ottom of the yncline.

In different localities the flexures will be found infinitely varied, and if the downward curves or basins extend deeply into the ground, the situation is most favorable for the formation and retention of ore beds. And it is important to note that beds thus situated may be expected to thicken and to improve in quality as they descend into the ground. The iron ore being more soluble than the silica in the ore, it may be expected that acid waters will carry down part of the iron, whilst it leaves the silica at the outcrop. I have proof positive of this in the case of the Hays or Colonial bed, as will be presented hereafter, and this is my hope with regard to all beds whose outcrops are extra silicious.

egularities escribed.

We cannot depend upon the absolute continuity of these ore beds as we expect of a rock bed. The pressure which caused the slates to be folded as we found them would inevitably be attended by irregularities in respect to direction and continuity. In some places, as at the Water Hole, the ore bed is bent almost at right angles, and is massed largely in a small space. We see something of the same change of direction at the Hays bank. We may also expect local crushes, where ores and clays have been indiscriminately mixed. I think this is the case where Mr. Leyburn first began to mine.

gain, the ore being usually harder than the clays, the emoval of the latter by weathering will not only loosen he blocks which we call float, but will sometimes cause 0 or 20 feet of the outcrop to fall over in a body without reaking away, and thus give an unnatural width to the ed. We also find large blocks of ore which do not eem to be connected with any bed, and yet they were ll once, in all probability, parts of a bed, possibly of an rch of ore once perfect, but long since broken and scattered on the top by the wearing down of the slates which upported them.

Other irregulai ities.

Besides these irregularities, there are other breaks in he continuity and size of the beds, even when they are s regular as we may expect to find them. The most ontinuous bed is only a string of boulders or pockets, eparated by cross partings of slate which may be only few inches, or may be many feet, in thickness. The utcrop of an ore bed may be only three feet across, but n following it down we may find it rapidly thickening ntil it may come to forty feet in diameter, possibly even ore in rare cases. But descending further it will be und thinning again. A similar state of things is found following the line of the ore along its strike. It may from 3 feet to 30 feet within 100 yards, and in another undred yards it may come down to three feet again, or cut off entirely; but if it be one of the leading beds will come in again in a short distance.

Depth of ore beds uncertai

There is no means of determining the depth to which ese ore beds descend. My impression is that the chief eds go to a considerable depth. The Colonial has been enetrated to a depth of more than 100 feet from the

Some beds dee

surface of the hill without any sign of exhaustion. If we may judge by the float found on the sides of the highest spurs, we have the right to conclude that some of the beds at least descend into the ground several hundred feet. This statement could be verified by cutting the same bed at the top and at the bottom of a high spur. The limestone heretofore described as lying in a trough of the slates shows itself in cliffs of 100 feet high on three creeks, and the indications seem to prove that the two ore beds which lie close to the limestone, one on each side, descend with the limestone below the bed of the creeks. This I think evident with the Jordan bed at the first and also at the second limestone. My impression is that rich discoveries will some day be made at the bottom of the basins which hold these ore beds, and the deeper the basins the larger the probable accumulations of ore.

Rich discoveries hoped for.

I now continue my descriptions of the several beds.

(5.) THE GLASGOW BED.

This is the bed which lies next above the sandstone, with a thickness of about 30 feet of slate between it and the sandstone. It is in fact a double bed, containing both manganese ore and iron ore. Where I have had the opportunity of observing, the manganese was below the iron ore. On the Jordan road to White's Gap the two beds seem to be separated by about 100 feet of slate. The manganese will be spoken of under a separate head. The iron ore on this lead is nowhere opened, so that I

Contains both manganese and iron ore.

Not opened.

nnot speak of the size of the bed, nor has it ever been orked on this property, except at one place, known as he Camper Bank, on the south branch of Stony Run. his was worked in the old furnace in 1861. The cut 100 feet long, 60 feet wide, and 30 feet deep.

There being no outcrop or opening, I was left to judge f this line of ore solely by surface indications. The oat is not very abundant, but it can be found at intervals om the lower end of the property near Enderly, certainly to the valley of Stony Run. I did not examine arefully the ground further on, but have no doubt that continues. In fact this is the fundamental bed that ontinues indefinitely north and south with the usual ariations. Whether this bed is within the projecon of Buena Vista land, which extends from White's un to Irish Creek, I could not determine, because could notlearn exactly the location of the property ne.

The fundamental bed, whic continues indefinitely.

The float, as seen everywhere, indicated a bed of excelnt quality with less than the usual proportion of silica. lthough lump float ore is comparatively scarce along e line, wash ore and deeply colored clay are so abundant to be notable. This leads me to think that the ore is iable and rich, and inclining to be aluminous rather than licious. There will be no difficulty in testing both uantity and quality on any of the spurs, although in ome places it is covered so deeply by sandstone debris s to give no outward sign of its presence. The surface ndications of this bed are as good on the Hart's Bottom roperty as on old Buena Vista, although all the ore lines n the Hart's Bottom and Green Forest properties are omitted from the map, because they have not been run with the compass. There will be no difficulty in adding them hereafter.

(6.) THE JORDAN BED.

t opened.

d cuts.

This is the bed which lies on the east side of the limestone and distant 500 feet from the Glasgow lead on Mineral Ridge, but varies in distance with the grade of the spur, etc. This is another persistent bed on which there was no opening showing the bed in place. Some old pits on the ridge north of Big Chalk Mine Run show that it was worked in former years. Here perhaps half a dozen cuts were made across the outcrop near together, the size of each one indicating that ore had been taken from this locality, though not in any great quantity. I took the sample for analysis from a pile of lump ore which was left at one of these cuts. This is the most northern point where I saw positive indications of the presence of this bed. For half a mile beyond the flat woods the outcrops are deeply covered with drift from the mountain. From the limestone on Big Chalk Mine Run to Mineral Ridge, surface indications of the Jordan bed are found on every spur. When I stopped the survey, men were digging for this ore on Lowman's Ridge with good prospect of success.

n in Red
Ochre Hollow.

In the Red Ochre Hollow the indications are quite decisive. On the north side of this hollow there is a line of ochreous clay of vermilion color, such as is often associated with ore beds, running up the hill about where this bed would be expected to cross; and on the south side of the same hollow there are numerous large angu-

ar blocks of ore of excellent quality lying on the hill-
ide near the same line. These shows are 165 feet east
f the base line on the limestone. Ascending the hill
outh of Red Ochre Hollow—which hill I call the Big Cut
Spur, owing to large old diggings to be mentioned here-
fter—we find on the crest a pit about ten feet in diam-
ter, from which evidently some ore has been taken.
t is not exactly in the line of the Jordan ore, and I sus-
ect the digging was in the float from this bed, the true
ine of which I would expect to find 200 feet or more up
he spur, or eastward from this pit. The line from here
o Little Chalk Mine Run is on elevated land about the
ead of Lost Hollow, and passing to the east of a rocky
noll reaches the run in its proper place near the lime-
tone. In the Spring Fork of Lost Hollow I saw lumps
f good ore immediately on the line, and on almost every
pot where the ground was visible it was deeply dyed,
nd peppered with particles of smooth, dark, rich ore.
n nearing the run the sign became more decided, and
ould guide the prospector to the underlying ore bed.
rom Chalk Mine Run to the end of the line on Mineral
idge, some recent abortive diggings were observed in
e wash of the flat land. Ascending the spur between
ittle Chalk Mine Run and Silver Mine Run, I observed
o float on the north side of the spur, which seems to be
eeply covered with humus and undecayed litter, but on
he south face of the spur there is a remarkable display
f deeply-colored earth, well filled with shot ore. From
he configuration of the hill, I think this is wash from
oth the Glasgow and the Jordan. Some small trial pits
ad been sunk in this wash ore without hitting the bed,
hich here must be sought by the compass, or by meas-

**Bloom on Silv
Mine Run.**

urement from the middle line. Crossing Silver Mine Run, and ascending the north face of Mineral Ridge, we we find a good show of blocks of dark, compact ore of excellent quality. This float lies about 100 feet east on the middle line. Excepting discolored earth, near an old pond on the top of the ridge, I observed no more sign of ore. I did not follow the line south of the top of Mineral Ridge, because most of the beds in this group become complicated with the building lots of the town. I rode over the line to the lower end of the property. No doubt most of the beds will be found on the spurs at the lower end on the unsold property.

I hope the Jordan bed will be fully tested. If the quantity of ore be in proportion to the quality, it will be highly valuable.

(7.) THE LEAKE BED.

This, at one time, was called the "*Forty Foot Bed,*" because its outcrop has fallen over so as to make an abnormally wide show at the top. It has been partially uncovered on the south side of Mineral Ridge, but scarcely enough to determine what is the normal width, or thickness, of the bed. I think, however, that it is a bed of good size, and contains ore of fine quality. I call this opening on the bed Walker on Leake. I will now describe the whole line of this bed, beginning at the south end.

he Leake or "40" bed raced.

It will be remembered that the Leake bed begins, so far as known to us, at the Walker opening, on the west side of the middle limestone, and here is about 200 feet from the middle line, which was intended to be half way between the Leake and Jordan beds. Descending the north side of Mineral Ridge, we find some ore beds near, but not on, the line. The first we meet I call the McKee bed, which I take to be a fragment broken from an outcrop, possibly from the Leake bed. The Leyburn bed, near the foot of the hill, when first opened, showed large boulders of excellent ore, together with outlying lumps and lean red stripes of ore, all much mixed with white and yellow clay, indicating a crush. On taking out this ore, the bed seemed to be exhausted. Some lateral digging was made in search of more ore, but without success. I did not doubt at first that this outcrop was a part of the Leake bed. Afterward my views wavered, but by the time I had finished my compass and chain work, I had returned to my first opinion. The Leyburn digging is about 150 feet west of the direct course of the Leake bed, and it is say 100 feet lower than the first opening, which, considered with the dip of the bed (35° N. W.), accounts for the position of the digging. Hence I call this Leyburn on Leake. The direction to hunt the lost ore is W. not E. of the Leyburn digging. In all searching for an ore bed, it should be remembered that the line of outcrop of a bed dipping anything less than 90° will vary with the inequalities of the surface of the ground, and however regular may be the course of a bed, its outcrop will be in a line only on equal levels. On lower levels the outcrop is to be sought in the direction of the dip. This can be made a matter of exact calculation.

Leyburn.

Bloom at Litt Chalk Mine Run.

The next indication I observed was alongside of the limestone and Little Chalk Mine Run. Here are to be seen lumps of float ore, also shot ore and an extensive discoloration of the ground on and near the line of the Leake bed. But there has been some sliding of the earth, which misled the diggers who endeavored to open the bed here. Following the line northward we find some large old diggings near the crest of the ridge on the south side of Red Ochre Hollow. There are two pits, each over 100 feet in length, and something less in width. There are two smaller pits immediately on the crest, of about 15 feet in diameter. No ore could be seen in or near these diggings, which shows that the miners valued the ore sufficiently to take it up clean.

on Big
ge.

Descending the hill into Red Ochre Hollow, I observed some large lumps of ore along this line, about the proper distance from the float before mentioned on the Jordan lead. Ascending the next spur (Lowman), we came to the new opening in which the outcrop of the Leake bed has been uncovered without being dug down upon. I call this Lowman upon Leake. The bed here shows a width of 20 feet 6 inches, the ore good, but a little more silicious, as shown on the surface, than it showed at the Leyburn or the Walker opening (the first).

ned on
wman's
idge.

At Big Chalk Mine Run the strata are dislocated by a cross fault. The limestone, with its accompanying beds, has been thrown westward 422 feet. Beyond this point I saw only discolored earth. At the limestone there is a ravine, where we would expect to find the Leake bed, showing that the outcrop had been washed away. I did not search the dense, brushy woods abou' Stony Run and beyond; but in this part of the territor there is less surface appearance of ore than is to be se' on the ground we have come over. There is more wa from the mountains covering the surface, which may par' account for the want of ore sign. On the old road fr the Camper bank to the furnace a lead of ore evide

ign diminish-
ing.

crosses the road in the proper direction, at the distance of 825 feet west of the middle line. I take this sign to indicate the presence of either the Barclay or the Colonial bed. I incline to suspect that it is the latter, on account of the small lumps of manganese found in the red clay, but it is on the course of the Barclay. The significance of this indication will be understood when I come to discuss manganese.

So far as I could see, the geological formations and flexures continue the same all the way to White's Run. The Glasgow lead on Stony Run is 3,300 feet from the middle line, instead of 500 feet, as it is on Mineral Ridge. This I cannot explain. More will be said of the Leake and other beds hereafter.

(8.) THE McCORKLE BED.

This bed indicates its presence at two places on Mineral Ridge, and at two places between Little and Big Chalk Mine Run. On the south face of Mineral Ridge are to be seen some old diggings and other signs between Walker on Leake and the Miller bed, which I take to indicate the presence of the McCorkle bed; and it may be that a small pit on top of the Ridge is on the same lead. But it has been fully opened on the north face of Mineral Ridge for a distance of 80 feet in length and 10 feet in width, tapering to nothing in the open cut at its lower end. Deeper digging will probably discover it farther on. Its course here is N. 20 E., which does not agree with that of either the middle line or the Barclay and Colonial beds, though nearer to the latter than the former. The main rib in the ore bed is vermilion in color, and aluminous. The rest is brown, with occasional nodules of fibrous or needle ore. There are more spangles and buttons of quartz and feldspar in the outcrop than one likes to see; but much of it is good, and by careful selection it will make a fair furnace ore; and it may improve downward.

The third indication of the presence of the McCorkle bed is on the knoll north of Little Chalk Mine Run, where a digging uncovered a corner of red silicious ore, which seemed to be part of a bed. This was 627 feet west from the middle line, which is almost exactly the distance of the McCorkle bed from the middle line on Mineral Ridge.

One hundred and sixty-five feet west of this bed, I observed float ore of good quality and small pits, which seemed to run in proper direction for a bed; but I observed nothing to correspond with it elsewhere. The space is not great enough for the Miller bed. It may be only a line of float from the hill to the east.

McCorkle again

The last strong evidence of the continuance of the McCorkle bed is on Big Cut Spur, where there are two old diggings parallel to each other and eight rods apart. The more easterly of these pits shows the outcrop, and the other holds the tunnel which struck the bed underground. The east pit is almost the same distance from the Barclay bed on one side, and the Leake on the other, that the McCorkle bed is from the same beds on Mineral Ridge. The character of the ore here and there is also much the same, though perhaps a little better here. It is a dark, heavy ore, with a small proportion of red aluminous ore—all somewhat speckled with silica. The larger pit is about 70 feet long, 30 feet tapering to 15 feet wide, and 15 feet deep. Heads of dark, fair-looking ore protrude from the sides of the pit. The overburden is only about 5 feet. The outcrop is on high ground, probably 175 feet above Big Chalk Mine Run, and the bed can be entered on its edge from Red Ochre Hollow.

I saw float on the line of this bed, half a mile farther on, in and near the road from the old mines on the Jordan bed north of Big Chalk Mine Run.

All this evidence, taken together, seems to justify us in classing the McCorkle with the continuous beds.

(9.) THE MILLER BED.

The only certain outcrop of this ore is in one place on Mineral Ridge, 600 feet from the McCorkle bed, and 180 feet from the Barclay bed, which comes next to it. When I first saw the Miller bed it showed a bold outcrop on the south side of Mineral Ridge. It seems to have a width of 25 feet, and was in heavy boulders. I sampled it, rejecting such parts of the bed as I thought would be thrown out in mining. At that time most of the ore looked well, in spite of patches of bad ore. The digging around the boulders left some uncertainty as to the depth of the ore, and when the boulders themselves were broken open, they were found to be thickly studded with crystals of milk-white quartz. On the north side of Mineral Ridge there appears float ore about in the line of this Miller bed, but upon the whole I doubt its continuity for any considerable distance.

(10.) THE BARCLAY BED.

I regard this as the dominant ore bed of the property. I do not mean by this that it yields the best ore, but it shows the greatest number of outcrops, and by the help of the compass it is easily traced from Mineral Ridge to near White's Run, a distance of nearly four miles. Hence it is useful as a guide. The visible part of the outcrop, however, is usually highly silicious, which accounts for its enduring the weather so persistently. The bed begins to show itself at the Monkey tunnel, in the south end of Mineral Ridge, and is readily traced northward along the point of the Ridge, which point, in fact, as before remarked, was left in consequence of the hardness of this ore. Two great openings have recently been made in the bed on the top of Mineral Ridge, displaying at each an amazing mass of ore lying in the most favorable possible position for mining out.

athews on Barclay.

The first opening is on top of Mineral Ridge, just where it makes the turn southward. There is here but two or three feet of cover over the bed, which has lately been stripped off for a distance of 30 feet along the outcrop. An approach has also been made on the east, which gives a side view of the bed to the depth of about 12 feet. Thus far the bed is vertical. It measures 36 feet across the outcrop, which should be diminished by an allowance of 5 feet for clay partings. Viewed from the side, there is some arching of ribs in the bed. There is one arch, 10 feet high and 7 feet wide, filled with clay. The sides of the arch are formed by about 4 feet of ore. There is another arch seen in the side of the entrance, cut where the appearance is that of a crust or peeling bent outward into a narrow arch. The bed generally is hard, gnarled and massive, liver-colored and reddish brown. Analysis (given hereafter) shows that, taking the whole face of the outcrop, the ore averages 30 per cent. of silica and not quite 40 per cent. of iron. By careful selection a passable furnace ore could be gotten here and at the next opening. I observed no improvement in the ore as far down as opened; but in the sequel I shall have something to say about the doctrine we find among the miners, that the ore improves downward. There may be something in it. This opening I call the Mathews on Barclay.

Campbell Barclay.

Following the strike N. 25 E. about 400 feet, we find another opening, where the bed is stripped for 17 feet, and shows the astonishing breadth of 88 feet. Probably this is another case where, as at the Leake, or "40-foot" bed, the outcrop has bent over and fallen flat, so as to give the surface a much greater width than properly belongs to the bed. There is no sign of this here except the abnormal width. I call this opening "Campbell on Barclay." The surface of the bed is in cavities and ridges, but is solid all over. The color is generally reddish brown and in places almost black, with stripes of red shale ore. In structure mostly compact, but in some places slaty and in others porous. Some feldspathic and quartzose bunches, which can be thrown out in mining. The average quality is about the same as at the first point.

Following the line from the new openings, we come to two old pits a few hundred feet distant, from which considerable ore has been taken for furnace use. One corner of the bed is visible in one of the pits. Some lumps of ore are lying on the bank, which show an improvement in quality, but it is considerably specked with silica. It may be advantageously worked in connection with the Colonial and other first quality ores. Following this line to the point where the bed crosses Big Chalk

Mine Run, we find an old digging, some 30 feet in length and 10 feet or more in width, now overgrown with bushes and nearly filled up. No doubt ore was here raised for furnace purposes. Crossing the creek diagonally upward we come to a new opening, which I call Secrist on Barclay. It is good ore, dark, heavy and much less silicious. The analysis shows its quality. The bed is not fully opened, but its outcrop as seen is at least 10 feet wide.

rist on
rclay.

The ore bed keeps close to the creek for the next quarter of a mile, crossing it twice. It gives signs of its presence at at least four points in this distance. At two places it shows boulders of ore, of fair quality, over two feet in diameter. At the upper place one of its silicious walls has been uncovered by the ground sliding away from it on a high bank on the west side of the creek. North of this point the bed angles off slowly from the line of the creek and enters the side of Hays Ridge, the outcrop climbing higher and higher upon the Ridge, passing about 400 feet east of the large pond, at which point I estimate that the outcrop is at least 200 feet above the bed of the creek. It passes on to the water-shed between the valley of Chalk Mine Run and the drainage into the Long Hollow. This water-shed is a sag in Hays Ridge, north of which there is a knoll which seems to have been made by the hard ribs of the Barclay bed. At the far end of this knoll we see a large development of highly silicious ore. Following the line with a pocket compass, I saw slight indications of ore on the Jordan road to White's Gap. Between this road and Stony Run, I came to the ore sign on the old Camper bed road, to which I have previously referred (page 46). Here is a wide belt of deeply-dyed earth, which can be traced as far as the

rclay bloom.

nganese and
on bloom on
ie Camper
ink road.

ground is uncovered. I found lumps of manganese ore, but no iron ore. I anticipate a good development here, but feel doubtful as to which of the bed s it is. The course may have changed, of which there are other indications. But it is on the Barclay course.

Float N. of Stony Run.

North of Stony Run, and on the side of a ridge corresponding geologically with Hays Ridge, if not in the same line, and especially in the gap of this ridge, I observed an abundance of silicious float, having the appearance presented by one rib of the Barclay bed further back. No attempt has been made to uncover the Barclay bed anywhere north of the Secrist bank; so we are left in ignorance of what the bed is underground beyond.

(II.) THE COLONIAL BED.

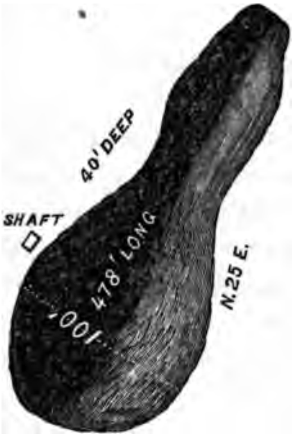
As stated heretofore, I labored under the disadvantage f not obtaining a fair sight anywhere of this great ore ed. My belief is that the Hays and Colonial beds are ne and the same. The former mining of the Colonial ed, excluding, for the present, the Hays bank, was hiefly, though not exclusively, at two points. One was t the well-known Water Hole, or Engine House pit, and he other in the big cut on Mineral Ridge, a few hundred ards south of the Water Hole. A little further south here was another opening made many years ago, from which a moderate amount of ore seems to have been taken. This is the most southern point where the Colonial bed has been opened, and I will make it the beginning point of my description of the bed, so far as I am informed about it. This old cut is 200 feet south of

Water Hole, Engine Hou Mine. (See 55.)

the great pit alongside of which Capt. Jordan is now sinking a shaft. The cut is 33 feet long, 25 feet wide and 15 feet deep, and so much caved in as to cover up all signs of the ore bed. There is a cart-load of ore lying out to one side. It is good ore, but somewhat spotted with silica. It may have been purposely left. Very recently some one sank a small pit in the old cut, but got only wash ore. This new pit is, I think, east of the ore bed. The line I ran passed a few feet west of the old cut. This part of the ore bed is said to be cut off by clay from the bed in the great pit.

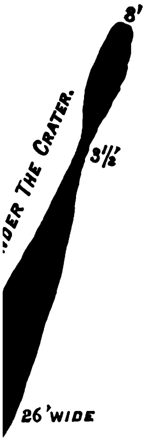
he Crater or Great Pit.

The great pit is 478 feet long, over 100 feet wide in its widest part, and forty feet deep. Its general shape is —



THE OLD CRATER.

There is no ore visible in or around the pit. The hill-side where it is found is 100 feet above Chalk Mine Run. This pit has not been mined since 1865. The ore taken out here was of very superior quality, though varying somewhat, as will be shown hereafter. It was clean, but loose and easily dug. The most particular account of the working I obtained from Mr. Downey, who is evidently a truthful man. He was the mine boss here until the destruction of the furnace in 1864. He then went to another iron works, but has lately returned to Buena Vista. Mr. Downey says the mine was first worked by stripping, and afterwards by shaft and tunnel. The ore has been taken out to the about 110 feet from the surface of the hill, for ːe of 500 feet in length. The bed was vertical, ed in size and quality. The thickness varied feet to 3 feet. The shape of the ore bed was g like this—



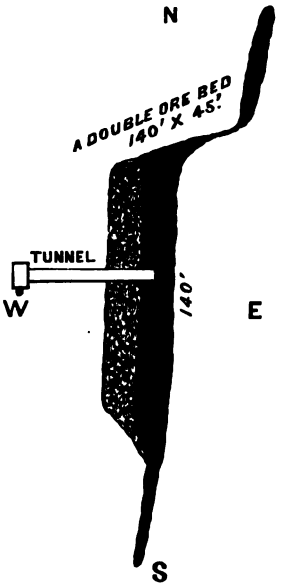
ED UNDER THE
ATER.

The working extended from the path at the south end of the pit to a point opposite the Chalybeate Spring. There was no failure of ore at the bottom of the mine. It still kept its full width; and trial pits in the bottom showed that the bed continued unchanged as far as the pits went.

Water Hole Mine describ

From the north end of this old mine (opposite the Chalybeate Spring), it is about 400 feet to the Water Hole, which is 35 feet west of the direct line of the Colonial bed. Whether this part of the bed gets out of line by means of a curve or a fracture cannot be determined. the dimensions of the block of ore be certainly ıed, there being no access to it at present. Putting the statements given below from Capt. Jordan, ›erintended the mining; A. S. McCreath, who he mine in 1883, and Prof. J. L. Campbell, who t in 1884, whilst it was still in operation, it seems ıt here is a solid block of very superior ore, not n 140 feet long, 20 feet wide and of unknown on the west of which block, and close to it, is bed of "fragmentary and nodular ore of good quality, about 25 feet thick and of unknown extent." It would seem that the ore from the solid block has been nearly all taken out to the depth of 70 feet, but there were no indications of failure below.

This deposit is so remarkable that I copy below the statements above referred to. Captain Jordan prepared his statement at my request; the statements of the other two gentlemen are taken from their published reports.



A DOUBLE ORE BED 140' x 45'.

CAPT. JORDAN'S STATEMENT.

A DESCRIPTION OF THE WATER HOLE MINE ON THE BUENA VISTA PROPERTY.

Some time between the years 1838 and 1840 my father, the late Samuel F. Jordan, was prospecting upon the Buena Vista property (then McClure's), with a view of buying it for an iron property, and as he rode across the ford on the Little Chalk Mine Run, just above where the engine-house now stands, and immediately over the present workings of that mine, he discovered a large rich black vein of iron ore in the bottom of the ford. This induced him to purchase the property. The freshet of 1842 covered the vein over at this point with gravel and large boulders to the depth of 10 or 12 feet. He could never find it again (although we made frequent efforts) until the year 1867. We then began working it on the surface and continued to work it down to the depth of 30 feet by means of open cut. Then I used horse-power whims to hoist the ore out. This I used one or two seasons. I then substituted this with steam pump and hoist machinery, and to operate this I sank a shaft about 60 or 70 feet west of the vein to a depth of 90 feet. I ran off a drift in an easterly direction to the vein at a depth of 50 feet from the top of the shaft. This drift was run out from the shaft into the open cut and worked one season this way. When I found it was more expensive to mine this way, on account of the banks of clay slipping in, I abandoned this, and went down the shaft to the depth of 75 feet, when I drifted off to the vein and struck the solid ore at about 70 feet from the shaft. I then drove a drift at right angles across the vein to the distance of 70 feet in good, rich, solid ore. At this point I struck the white clay or chalk. I then came back to where I first struck the vein and ran off a drift at right angles in a westerly direction and encountered 70 feet of lump and fine ore before I struck the clay on the west side of the vein. This, in my opinion, is one of the largest and richest veins of Brown Hematite to be found anywhere in the State.

We have never reached the bottom of this vein, although we have been down 170 feet by means of shaft. During a series of years, from 1848 to 1884, these mines have been almost continuously worked, and the ore used in our charcoal furnaces at Buena Vista and Amherst Furnace. The workings of these ores in our furnace prove conclusively that we never get less than 50 per cent., or one ton of good No. 1 foundry iron for every two tons of ore. We have had some blasts run our yield up into 60 per cent., when we would strike extraordinarily rich sections of the vein. We have kept an account of the practical test in our Amherst Furnace for some ten years and find the yield to be 53½ per cent. on an average of ten years' workings.

When we suspended work in 1884, the ore was in the bottom of the workings to the width of 140 feet. The shaft has been sunk to the depth of 90 feet, and if the timbers should be found to be sound there could be a drift run off at this depth, and entirely under our old workings. I doubt very much the feasibility of working this level, as I think it has fallen in very much.

Yours truly,

C. F. JORDAN.

PROF. A. S. McCREATH'S STATEMENT.

"Where the present operations are being conducted the ore has been worked by open cut, shaft and side drifts. This is known as the *second or engine-house opening*, and is situated about three-fourths of a mile east from the Shenandoah Valley Railroad. The open cut consists of a circular pit 100 feet in diameter and nearly 50 feet deep, from which a large amount of ore has been mined. The ore comes near the surface at points, with probably an average of 6 feet of stripping. At the edge of the deposit, and outside of its limit, a shaft has been sunk to a depth of 91 feet; and it is by means of this that the present mining operations are being carried on. At a evel of 50 feet a side drift was run in, and about 5,000 ons of ore mined from this point. But the present work- ngs are on a lower level, viz., at a depth of 76 feet. Iere a side drift, in an easterly direction, has been run in r a distance of 72 feet, where the ore bed was reached; hence in the same direction for 65 feet in good, rich, lmost solid ore. At a point 27 feet from where the ore vas first struck, a drift runs in a S. S. W. direction for 63 eet through the same general character of ore. A slight linty horse-back, 7 to 8 feet wide, was encountered 27 eet from the north end of this drift. But the occurrence eems purely local, for another drift in an easterly direc- ion at this point goes through 20 feet of good, rich ore, lmost solid, with but few flint streaks.

"The general 'strike' of the ore deposit is north-east nd south-west, with an easterly dip; and it has been aced in a south-west direction for a considerable distance. here can be no doubt but that the deposit is an exten- ve one. The bank yields one-half clean lump ore; and e bulk of the so-called wash ore must be simply the mp ore broken up in mining, for at no point examined es the bed show much clay. The fine ore washes three- urths clean ore. The washer is located at the North iver of James, three-fourths of a mile distant, easily eached by down grade. The shaft is 15 feet long, run y water-power, and it has produced as much as 50 tons f clean ore in one day of 12 hours. But the daily ut-put of the mine is at present only 20 tons, all f which is shipped to the Company's 'Amherst Fur- ace,' on the James River, 20 miles distant. The mine s well timbered and in good condition, and can be nade to yield a much larger out-put, especially if worked by open cut. The hoist is worked by a twenty horse-power engine; and a steam pump keeps the mine quite dry."

PROF. J. L. CAMPBELL'S STATEMENT.

"We descended by a shaft to the depth of about seventy (70) feet, and on entering the tunnel, through which the ore is conveyed to the shaft, we passed at a short distance from the entrance through a bed of fragmental and nodular ore of good quality, about twenty-five (25) feet thick and of unknown extent. We then came upon a massive bed or vein, from which the miners were 'quarrying' ore of superior quality, an average sample of which gave us on analysis 56.15 percentage of metallic iron, with a small percentage of silica. This bed had been struck a little obliquely by the tunnel, and penetrated for a distance of twenty-five (25) feet. It is nearly vertical, but after allowing for a little variation from a perpendicular plane and for a very moderate obliquity of the tunnel, we estimated the width at twenty (20) feet of apparently good ore. Appearances all indicate the existence of large quantities of ore still to be obtained from this locality."

Colonial bed traced.

The Water Hole is the point of junction between Big and Little Chalk Mine Run. The direct course of the Colonial bed crosses Little Chalk Mine Run 35 feet east of its entrance into the Water Hole. On the north bank of the creek and 30 feet from it, there is an outcrop of ore on the line. A little tunneling and shafting have been done here, but this is the point where the bed turns into the Water Hole, and it seems to have been thinned, if not broken. Fifty feet further on we cross a large ditch, originally cut as a channel for diverting the water of Little Chalk Mine from the mining at the Water Hole. In the bottom of this a corner of the ore bed has been uncovered. At 165 feet farther we pass an old shaft in which Captain Jordan struck the ore at a depth of 20 feet, and mined for a time. He says the bed there was 20 feet wide. The course from here soon reaches the channel of Big Chalk Mine Run, along the bank of which are two old pits made by Captain Jordan; one of them 75 feet long and 16 feet wide, and the other 40 feet long and 16 feet wide, now filled with mud and water. A boulder of ore is visible in the first. Captain Jordan says that his mining here was stopped by a freshet which filled his pits with mud. At the end of the upper pit the line crosses the creek diagonally, and gradually climbs the side of Hays Ridge, which runs N. E. At the creek the line passes the point of the clay pile which has been dumped from the Hays bank. To this we will presently return.

Old shaft.

Old diggings.

Following the direct course without regard to the irregularities of the ground, and crossing a water gap in the ridge, we reach the top of Hays Ridge in about a fourth of a mile from the point where the line crossed the creek and follow near the crest of the Ridge, crossing a second hollow, which is the outlet from the *Big Pond*, and passing along the Ridge a little east of the Pond, we finally reach the sag where the road to the old furnace crosses, beyond which I did not follow the line. I found lumps of ore only in the first hollow, but on the mountain, especially near the Pond, I saw numerous areas of deeply-colored earth and shot ore, indicating an ore bed.

At my suggestion some digging has been done near the first hollow above the Hays Bank. Two, or perhaps three, considerable pockets of ore have been struck, but no continuous bed up to the date of this writing.

THE HAYS BED.

This has been the puzzle of miners and geologists, and is sufficiently phenomenal and economically important to justify a careful study and description. Much mining has been done here, chiefly by means of a vertical cut from the top of Hays Ridge nearly to the level of the creek, perhaps 100 feet long or high. There was also a little mining by tunnel near the bottom. A comb of ore 10 or 12 feet thick is now seen in the middle of this vertical cut, projecting diagonally from the Ridge, as if the ore bed were not lying on the front of the Ridge, but went into and diagonally across it in a due north course, instead of N. 25 E. At the top of this comb the crest of the Ridge drops rather suddenly to the south-west, and over the declining crest the sheet of ore bends or arches for a few feet.

Near the bottom, where the cover is greater, the ore changes in quality and condition, becoming richer and boulder-like, and apparently no longer a continuous sheet, as above. The difference in appearance is so great that one can scarcely believe that it is the same bed of ore, and yet the top rests upon and passes into the bottom so obviously that there is no room to doubt as to their being the same bed. The bed dips at an angle of 35° S. E., and is dropping directly toward the Colonial bed, whose outcrop is now separated by only a few feet of

Iays and Colonial the same.

clay. The digging now going on will probably prove in a short time that this and the Colonial are one and the same bed; and as the mining continues we may see how it is that the strike of the two parts seems to differ. But as a means of reconciling our minds to any inconsistencies in the facts as they are presented, we should observe the fact that this little secluded valley of Chalk Mine Run has been scoured out by tremendous floods, whose rounded boulders bestrew the face of Hays Ridge close by the Hays ore bank, and which have caused many now hidden irregularities in the ore bed which may hereafter be discovered. I see nothing inconsistent with the theory that the Colonial bed extended to the top of the Ridge here, as it does farther on. The difference in the quality of the ore at the top and the bottom of the Hays bank has heretofore been explained as owing to the leaching out of part of the iron at the top and its redeposition at the bottom. This may have been partly a chemical and partly a mechanical process, by which the lower part of the ore bed was both enriched and enlarged.

Floods and boulders.

Difference in quality between top a bottom explained.

(12.) THE MOOMAW BED.

This supposed bed completes the series of upper Potsdam ore beds. I call it a supposed bed, because I presupposed its existence as a geological necessity; and, second, because when I looked for it I could find only a scattered line of float. I do not doubt its existence or the excellence of the ore, but I can give no opinion as to the size of the bed; nor can I, without further examination, point out a sure place to dig for it. Its place is about 1,500 feet west of the Colonial bed, superficial measurement, and on the west side of Hays Ridge. Its line crosses the creek near the ford behind Capt. Jordan's house, and is there indicated by some lumps of good brown ore. Following the course from here, lumps will be found with sufficient frequency to confirm, if not to demonstrate, the theory of another bed of excellent ore, whose existence seems not to have been suspected heretofore.* Turning southward, we find the line passing a little east of the Hotel, barely touching the point of the spur beyond the Hart's Bottom house, and striking close to, if not into, the ore bed lately opened in the bluff near the Enderly boundary line.

This completes the list of Primordial or Potsdam ore beds, and brings us to the ores of No. II., namely:

(13.) THE LIMESTONE ORES.

Concerning this group of ores, I may as well say that little or nothing has ever been expected of them by the owners of the Buena Vista property. I know of no digging or discoveries of consequence ever having been made on the line in this region, and I have seen nothing to justify any sanguine anticipations. But this group should not be ignored, because, first, it is exactly the line where are found the best ores of this Great Valley, from the Delaware River to the Black Warrior; and, second, because on Buena Vista there is every indication of the presence of ore beds, be the same large or small. As indicated in my geological statement, the iron-bearing limestones (Quebec, or Knox Dolomite) pass through the Buena Vista lands on South River about the Old Furnace. I cannot map their exact area, but it is safe to say that the

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* This is the bed that passes under the Limestone, No. II., and may extend a long way under.

Indications ore.

vhole group (possibly duplicated) passes for a mile across he property. Within this area I saw numerous places here the ferriferous clay, generally specked with rticles of clean limonite, offered guidance and encourage-ent to the prospector. These places are to be seen on e main road from the Old Furnace to Green Forest, and ill more encouragingly on the road to White's Gap. ow and then a lump the size of a man's fist would be et with. Of course we should prefer that the float ould be large and abundant, and usually it is so when ere are large beds beneath. But there are exceptions. rge deposits of first quality ore of friable texture metimes show on the surface only pepper ore and dis-lored clay, and where there is much wash or drift the rgest beds may be wholly concealed. Whatever might the success of the digger in finding large beds, there n be no doubt that a jet of water turned on these beds ould concentrate large quantities of rich ore. These mestones, where standing at a high angle, as here, are ometimes decomposed to a great depth, and when this the case the ore may accumulate far down. I observed o sign of superficial beds or pockets, such as are com-on among the limestones; beds accumulated in basins mechanical washing from a distance, or by deposition om solution. By these notes I only mean to call atten-on to the indications and the possibilities.

Coloring and bleaching of the clay usually results om the presence or absence of iron oxides. The yellow d red clay has received its color from iron, whilst the hite clay, which lies above and below the ore beds, has een blanched by the leaching out of the iron, which has ecome massed in the ore bed. The high red color which we depend upon as a guide to ore beds has usually been derived from the recent decomposition of ores or ore-bearing rocks. In time they also will be blanched, and their iron oxides accumulated in beds somewhere.

All of the above described lines of ore are laid down on the large map accompanying this Report. The map was made by Mr. W. J. Hurlbut, of Buena Vista. These lines are prolonged only so far as I made personal observations, and are not meant to intimate that the ore in any case stops where the line stops. Could I have taken more time, I would no doubt have lengthened all the shorter lines.

REMARKS ON THE BUENA VISTA IRON ORES.

The most of what I have to say under this head has already been said or hinted at; but, as a practical summary, I will rearrange my observations, with additional matter, under the following heads:

1. Quality of ores.
2. Quantity of ores.
3. Accessibility of ores.

(1.) Quality.

Every one acquainted with iron mining (or any other ore mining) knows how irregular are all ore deposits in respect to either quantity or quality, or both. We find such irregularities on Buena Vista, but *less than usual.* The upper Potsdam ores (those usually worked) of Buena Vista not only average better than Potsdam ores generally, but they furnish more workable ore in proportion to the whole body of ore than is found on any of the other ore leads of the Appalachian

Impurities i
noted ore be

Range. All have to contend with silica and phosphorus. Even the best Cranberry magnetite, though low in phosphorus, carries but 45 per cent. of metallic iron, and is very expensive to mine, whilst other mines on the same lead have been much worse off than Cranberry. The Oriskany ores, which are worked in the furnaces about Clifton Forge, often, perhaps commonly, run from 20 per cent. to 30 per cent. of silica. Sometimes less, of course, but the unworkable ores in the beds are in larger proportion than the workable. The Clinton ores, taking the whole line from Pennsylvania to Alabama, are *generally* too silicious for the furnace. Not one-twentieth part of the Alabama Clinton ores can be smelted with economy; and yet the Clinton beds are the great dependence of the Alabama furnaces. A better showing than this could be made, if we should take into the comparison the inter-sandstone as well as the super-sandstone ore beds of Buena Vista. The shale ore bed, where it exists, is, I suspect, always of superior quality. And the Patrick is one of the great beds of the future. But of course the Potsdam ores are the chief resource. So far as the evidence is now before us, the unworkable ores are exceptional. There are parts of the McCorkle and Barclay beds which could not now be worked profitably. But I confidently expect that much, if not most, of the ore on both these leads can be worked to advantage in mixture, if not alone. And as for the Glasgow, Jordan, Leake, Colonial and Moomaw, I regard them all as high-grade ores. Any over-silicious ore in them will be local and exceptional. I make these remarks as prefatory to the tables of analyses, which otherwise might not be understood, and which fully confirm these general statements.

The average
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Buena Vist

ades of iron roduced.

The ores are adapted to the production of foundry and mill irons of good quality. At one time the iron was sold for car wheels, but the content of phosphorus is rather high to expect sufficient toughness for this use. By mixing the specular ores of the Piedmont iron belt, which are only forty miles distant, car-wheel iron could be produced regularly. In the Lehigh Valley these ores are generally mixed with neutral ores.

POTSDAM ORES ELSEWHERE.

On Cripple Creek, in south-west Virginia, the ores in the Potsdam group seem to be somewhat inferior to those of Buena Vista, if we may judge by the report of Messrs. McCreath and d'Invilliers. In a paper read at the Meeting of Mining Engineers in 1887, they gave the following figures as characteristic:

Average of ores in Potsdam slates in south-west Virginia—

Metallic Iron.....	51.100	44.700	52.400	49.550	49.450
Phosphorus......	.399	.539	.554	.117	.530
Silicious Matter.	10.150	19.590	7.620	8.810	10.020

A little later the same gentlemen, in their volume on the Cripple Creek region, give the following averages of the same ore:

Metallic Iron..................................	48.750
Phosphorus..................................	.329
Silicious Matter............................	12.892

Mr. McCreath, in his Report on the Mineral Wealth of Virginia, gives as the general average of the Shenandoah Valley ores:

Metallic Iron..................................	48.648
Phosphorus..................................	.259

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The ores are adapted to the production of [illegible]

He also gives the following average for the ores of the Cumberland Valley, Pa., which is a continuation of the same Potsdam ore belt:

AVERAGE OF THE ORES OF CUMBERLAND VALLEY.

Metallic Iron	42.950
Phosphorus	.464

At the end of these analyses he makes this surprising statement:

" When to the above is added the fact that the brown hematite ores, at present being mined in the Lehigh Valley, will not yield *over* forty per cent. iron in the blast furnace, it will be seen that the ores of the Shenandoah Valley rank high."

The ores of Buena Vista show to great advantage in comparison with these figures. The seventeen analyses of these ores were made from samples selected unsparingly from the worst ore as well as from the best. Yet we have the following—

Demonstrat superiority the Buena Vista ores.

AVERAGE OF BUENA VISTA ORES.

Metallic Iron	51.411
Phosphorus	.222
Silica	12.622

The best ores of Buena Vista, which were the only ones worked in former times, yielded an average of 53 per cent. of iron, and taking the average as we have given it above, we may expect something like 50 per cent. of iron; certainly this may be calculated on with a proper selection of ores in mining.

There is no sulphur in the Buena Vista ores worthy of note.

(2.) Quantity of Ores.

onsumption of ore by a furnace.

The quantity of ore on Buena Vista is certainly large but cannot be estimated accurately, because we do not know either the depth or the average width, or even the length, of any of the beds. Nor do we know what interruptions there may be in the continuity of the beds. Nor do we know the character or even the weight of the ore as it lies in its bed. But this is a sort of uncertainty which attends all mining on ore beds which have not been tested by the best methods of mining engineering. What we have learned creates a strong probability that the supply is ample to feed a furnace for many years without any assistance from the neighboring ore beds. If we could reasonably expect a supply for twenty years, we should be satisfied. May we venture to cherish this hope? Prof. Lesley says that a cubic yard of Potsdam ore in Pennsylvania will weigh a ton and a half. On this basis a furnace consuming 200 tons a day for 300 days in the year would require annually a mass of ore a mile long, 10 feet wide and 20 feet deep. If we had such a vertical bed 100 feet deep, this block would feed the furnace for five years, and four such beds would feed it for 20 years. Or, to lump the whole, the furnace in 20 years would use up a block of ore one mile long, 40 feet wide and 100 feet deep.

stimate of ore in one mile of Buena Vista.

Now the practical question is, have we a right to expect that the seven or eight beds of the Upper Potsdam ores will furnish this amount of ore? Let us consider *one mile* of the territory, beginning with Mineral Ridge and ending half way between Little and Big Chalk Mine Run.

Omitting the Miller and McKee beds as undeveloped, and all pockets, float and superficial wash ore, we must, in order to get 40 feet of width, have an average of 5 feet 9 inches in the seven beds. Let us see : The Leake bed was long called the "40-foot bed," and had it been as wide as that for a mile and 100 feet deep, it might in itself have furnished all the ore wanted in 20 years. I know not what is its normal width, but we find it over 20 feet beyond our first mile. Let us call it 10 feet wide, which is probably too little. The McCorkle bed, as far as seen, gives about the average wanted. The Barclay bed shows a width of 36 feet in one place and 88 feet in another. Of course no such average will be expected. Reduce it theoretically to 15 feet of workable ore. The Colonial bed runs from 3 feet to 26 feet. Average it at 10 feet, and we already have 40 feet in width, before estimating the Glasgow, Jordan and Moomaw. These supernumerary beds are all good ores, but as we do not know anything of their thickness, we will leave them as a reserve to supply breaks, bad ore, etc.

In respect to the depth of the ore, we know that the Colonial bed was mined down for 75 feet, and tested still lower at the lowest point on the property, the Water Hole; and that on the hill the mining of the same bed descended over 100 feet without diminution. And as to the other beds, we find their outcrops along the creeks from one to two hundred feet below their outcrops on the hills, and ore sign all the way down the hill-sides. This seems to make sure of a great depth in the hills at least. There has been no mining below the water level except in the Water Hole, and this testifies to as great a depth below the creek as above it. Besides the ore that lies in the folds of the slate, we may find that the ore bed nearest the overlying limestone group (No. II.) dips indefinitely beneath the limestone. Prof. Lesley, Chief of the Pennsylvania Survey, argues in favor of the probability of a great extension of the ores beneath the No. II. limestones.

re in the sec- nd mile.

So much for the chances in this one mile. We seem to have more than enough. How is it on the second mile, north of this one? In this are the large old diggings on the Leake, McCorkle and Jordan leads, now fallen shut, and the recent cut on Lowman's Ridge, which shows the Leake bed to be at least 20 feet 6 inches wide at the outcrop. There are also the float and wash ore heretofore mentioned in Lost Hollow and Red Ochre Hollow. In this second mile also occur the outcroppings on the Barclay bed, and the float and wash ore on the line of the Colonial, which I described as occurring on Hays Ridge in the neighborhood of the Big Pond. All of which shows that there is a large amouut of ore in the second mile.

hird and ourth miles.

In the third mile is the old Camper bed on the Glasgow lead, the pea ore, etc., on the White's Gap road, and the wide show on the old Camper bed road. In the fourth mile occurs the float on the Ridge near the old Camper dwelling-house. Judging by what is seen on the surface, one cannot estimate the third and fourth miles as high as the first and second, and yet no doubt there is much ore on this stretch.

e on Green orest and lart's Bottom.

To all this add the ore beds of the Green Forest and Hart's Bottom Tracts, a distance of over a mile at the south end. We may depend on having the Glasgow bed all the way, the Jordan most of the way, the Leake part of the way, and probably all of them for the last quarter to half a mile.

Abundant su ply.

Putting all these indications together, we may feel ure that the deposits of iron ore on Buena Vista make n immense aggregate; far more than enough to supply he stock for a single furnace.

(3.) Accessibility of the Ores.

Easily reache and self-drain ing.

One can scarcely imagine a state of things more favorble to reaching the ore than is found here, except the act of clay walls instead of rock, and a high dip instead f being horizontal. But it is extremely rare for ore beds o lie horizontal. I know of none such except the caronate and kidney ores of the western coal measures. The bulk of Buena Vista ores lie in high mountain spurs, ut across by ravines, which will enable the miner to pen the beds on their edge in every hollow, and when hus opened, either by tunnel or open cut, the mines will e self-draining. The outcrops of the ore beds are in many places 400 feet above the North River, which can e made the line of drainage. Most of the beds run two o three hundred feet above water level. Even the Colonial, which has so far been mined in the low places, high on the Ridge for most of its distance. I do not e why pumping need ever be resorted to, except when ining below the beds of the streams.

The depth of cover on the beds varies greatly. It is course deeper usually near the base of the hills than n sides and top; deeper in all places where drift has been eposited than where there has been nothing more than e ordinary residuum resulting from decomposition or in wash. On the summit or steep sides of spurs the erburden may be put at one to six feet.

'ost of mining. Concerning the actual cost of mining, I have not sufficient information to justify me in giving estimates. When an ore bed is fairly reached the cost cannot be large. The uncertain element is the search for the ore where there is a heavy overburden, or where the bed is crushed and dislocated, or cut off by clay partings. This expense is lessened by the geological study, and surveying and mapping of the property. Prof. Lesley puts the usual cost of mining the Potsdam ores in Pennsylvania at $1.45 per ton, besides a royalty of 37½ cents to 75 cents. I do not know whether this includes the dead work of prospecting or not. I judge from the reports that the mining of this group of ores in Pennsylvania must be more costly than it need be on Buena Vista. The price of the ore at the mine is put at $3.50 per ton; though of course this varies.

Iydraulic mining. Without having had much opportunity for observation in the matter, I incline to think favorably of the employment of hydraulic mining in the exploitation of these ores. They lie in sandy clays, which could be swept off rapidly by a jet of water, and much more cheaply than they can be moved by pick and shovel. And the available quantity of ore would thus be largely increased by the saving of vast quantities of wash ore, which could not economically be carried to a washer, and by uncovering pockets and small beds of ore which otherwise would be neglected.

I can give no opinion as to the proportion between the wash ore and lump ore in these beds. Certainly the lump ore is in full proportion; but of course ample washing arrangements will be required. The washer at the old canal is said to have a capacity of 50 tons a day. But the closer the washer can be gotten to the ore bed the better.

The principle of concentrating iron ores has been adopted in the preparation of the New York and New Jersey magnetites, which are imbedded in hard rock. The trouble is to get the rock and ore separated, and this is now done experimentally by breaking up the ores, and jigging and sluicing them. With the Potsdam ores the silica might possibly be removed in large part by the same process; but I am not sure that the difference of specific gravity between quartz and limonite is sufficient to render this process practicable.

All down grades.

Early in the report I stated that all the products of Buena Vista could be brought to the site of the town on down grades. This statement is literally true. Begin at Enderly, and it is easy to see that this is true in respect to all the territory up to the mouth of Chalk Mine Run It must be true also of all the region drained by Chalk Mine Run and its branches; and in this area we have the heart of the mining region. Long Hollow accommodates a large area. Beyond the Jordan road to White's Gap the valleys of Stony Run and White's Run would bring everything to the Shenandoah Valley Railroad and South River, and all the land west of South River slopes to the river. So that all minerals, timber, agricultural products, etc., can be brought to the town, factory or furnace, at the minimum cost of transportation.

I have now said all that I wish to say at present concerning the iron ores of the Buena Vista property. Persons the most largely informed in respect to iron ore beds generally, and particularly in respect to this well-known line of ores, will be most impressed with the magnitude and excellence of the Buena Vista ore beds.

(b.) MANGANESE ORE.

I have taken up so much space with iron ore that I must be brief on the remaining topics.

I observed manganese float, wad, cream, and umbery earth on at least three lines running with the iron ore lines. The float was chiefly pyrolusite, with a proportion of its impure form of psilomane. Some specimens of fibrous and radiated pyrolusite were singularly beautiful. The black color has a slight bluish tinge, which I think is not always seem in this kind of ore.

The principal line of manganese forms a part of the Glasgow lead, and, so far as I could judge, lies nearest to the sandstone, and about 100 feet below the iron ore bed. The decomposed outcrop of this bed has been dug into on the spur on the lower end of the Hart's Bottom place, and also on the spur immediately north of Chalk Mine Run; but in neither of these places did the excavation reach the solid ore. On the next spur, north of the last-mentioned, the bed has been uncovered to the depth of about 10 feet, showing 3 feet in diameter of good solid ore. It may be assumed that this bed of manganese is continuous for the whole length of the property.

inganese sign i five differ-it lines

I also saw manganese signs overlying the Jordan iron bed north of Big Chalk Mine Run.

I have heretofore mentioned that I also saw lump ore and umbery earth on the old Camper bank wagon road, about 800 feet west of the middle line. The show here was so good that it ought to be fully opened.

Capt. Jordan dug into a manganese bed on the west bank of Chalk Mine Run, a short distance below the Hays Bed. He only threw out the decomposed outcrop, which, however, seemed sufficient to show that there is here a regular bed of manganese several feet in thickness. This manganese geologically underlies the Colonial, or Hays ore bed. An effort was made to reach this bed by boring between it and the line of the Colonial bed, but without success, the explanation of which seems to be that the ore beds here do not (as was supposed) dip eastward, but that they are vertical. I should have remarked heretofore that wherever I could see the slates they were dipping westward until I neared Hays Ridge, where the dip became vertical, and then dipped eastward. This can be seen in the large artificial ditch north of the Water Hole, and then on the road behind Capt. Jordan's house. Had the boring continued, the manganese bed must ultimately have been reached. I suspect that it is the same bed as that on the Glasgow lead. Manganese float was mentioned also in connection with the Patrick bed on Chimney Rock Mountain.

Large beds to
hoped for
the deep bas

The great hope for manganese on this property is in finding accumulated beds in the axes of the synclines, as at Crimora. Certainly the geological structure could scarcely be more favorable for such accumulation than here. Every repeated fold offers a basin for holding the ore. It cannot be affirmed with certainty that such beds will be found, and yet there is adundant encouragement to justify considerable expenditure in boring for them. But the utmost care should be taken in the location of the bore holes, so that they may be in synclines, instead of in anticlines. I felt disappointed that I did not see exactly the course of the flexures, and hence could not determine how the different ore beds were geologically connected, and for this reason I feel doubtful as to what ace to bore.

suggestions I should make in reference to boring for manganese. The largest deposits are to be expected in the middle of each basin, but unless the flexures are understood it is impossible to say just where the bottom of any basin is. It is possible that the Glasgow sheet of manganese ore may follow waves of the slate deep under ground, and not again come to the surface; or else come up on some distant line, such as the one of which we have indications west of the Colonial bed. A bore hole, started on the middle line penetrating the limestone and the underlying slates, even to the sandstone, if necessary, would certainly pass through the principal basin, if the strata were vertical. But inasmuch as the rocks dip at an angle of 35° or 40° west, it would be necessary to move the line of boring proportionately westward. There would still be some uncertainty because of our ignorance as to the depth to which the limestone descends before reaching the axis of the syncline. My present impression is that a hole put down near the line of the Colonial bed would have the best chance to strike the middle of the principal basin, but I should wish to study the structure more carefully before advising such an expenditure as might be required to reach the manganese.

onomy of expenditures for rospecting.

I wish to make this general remark with regard to *prospecting* on a property like that of Buena Vista: Assuming that its geology has been thoroughly worked out and displayed on maps and sections, and that the search is conducted in accordance therewith, I regard liberal expenditure for prospecting as a wise economy. Even one fortunate find may indemnify the company for all it has expended, and here you have reason to hope for numerous discoveries which will pay for the prospecting many times over. Concerning the manganese ore, it is quite possible that beds may be found near the surface of sufficient thickness to justify working. Trial pits should be put down at short intervals the whole length of the property.

(c.) CLAYS, OCHRES, UMBER AND SAND.

Clays.—The development of clays on Buena Vista is simply magnificent, and I believe that the constituents of these clays existing in endlessly varied proportions will be found to fit them for almost every variety of use to which clay is applied. In its original form there is too much alkali and iron oxide to be used for burning. The alkali acts as a flux to the silica, and the iron imparts colors such as are wanted only in house bricks and coarse earthenware. These clays, having been derived from the damourite slates, and they from the older rocks, chiefly granite or gneiss and syenite (composed of quartz, feldspar, mica and hornblende), must in their original form contain silica, alumina, lime, potash, soda, magnesia, phosphoric acid, sulphuric acid, iron compounds, etc. But the decomposition of the slate is occasioned by the dissolving out of part of its elements, particularly its alkalies, and a clay residuum is left, which continues to change by the segregation of its ferric oxide and the progressive leaching out of its remaining alkali. As these transformations progress the clays become fitted for different uses. Moreover, in the original constitution of the damourite slates, there are variations in their composition, especially in respect to the content of silica, which ultimately adds to the number of uses to which their clays may be applied.

ys classified.

The chief varieties of clay may be classed into (*a*) potter's clay, in which I include all clays used for earthen and china ware; also ordinary pipe clay: (*b*) fire clay, in which I include clays for fire brick, terra cotta, all sorts of furnace linings, etc.: and (*c*) brick clay, for ordinary purposes.

tery in Au-sta county.

Whilst I suspect that these Potsdam clays, together with the lower limestone clays, would yield every variety of clay wanted, there is no telling in advance where any particular variety will be found. The chemist and experimenter must decide. I suppose that generally there is too much alkali, too much silica, and too much iron for most uses, and clays adapted to practical uses may be exceptional, but still may be sufficiently frequent and abundant to deserve attention. In Augusta County, near the Rockbridge line, a pottery was established where an excellent stone-china was made during the war and since the war, from kaolin beds in these clays; and fire-brick clays have also been proved to exist in the same locality. In Pennsylvania the pure white kaolin has been used from these clays for *weighting paper*, for which purpose it was bought by the paper mills at $7 to $15 per ton. The kaolin was divided into three grades. No. 1, white; No. 2, mixed white and yellow; No. 3, buff color. No. 2 brought $9 per ton. The work was discontinued upon the exhaustion of bed No. 1.

Concerning the clays on Buena Vista, I cannot speak with much definiteness. There are certainly clays of all colors, and among them white clays. Chalk Mine Run is named from a bed of white clay, which was used at one time (among other things) for blackboard chalk. I did not see many good-looking beds of white clay, though no doubt many such exist. They are generally found associated with iron ore beds, their coloring matter having gone into the ore. Yellow clays abound. It is thought that the clays west of Hays Ridge are best for brick and fire-brick.

A valuable c

The only sample I took for analysis was from a bed of *white clay*, as I called it, which, however, was proved to contain more white sand than clay. It is the bed, about 10 feet thick, which overlies the ore at the Hays bank. Prof. Hardin analyzed it, and thinks it valuable for making the extremely refractory linings known as Dinas bricks. I give Prof. Hardin's report on this clay :—

Lexington, Va., July 31, 1869.

Dr. W. H. Ruffner, Lexington, Va.:

Prof. Hardi
report on
Dinas clay.

Dear Sir: I have made a very careful examination of the material received from you June 8th, and marked "White Clay from Buena Vista." It is rather a sand than a clay, as the following results show :

The air-dried sample yielded 0.06 per cent. of moisture at 100° C.

I. MECHANICAL ANALYSIS.

Sand, of moderate fineness................	46.49
Sand, very fine, impalpable................	40.77
Clay..	12.74
	100.00

I have included all water of combination with the clay in this table, as it unquestionably belongs almost entirely to it, a microscopic examination having shown that the sand is composed of quartz, which, to a considerable extent, is in very distinct though minute crystals, while the clay is made up chiefly of kaolinite.

II. CHEMICAL ANALYSIS.

The sample dried at 100° C., contains in 100 parts :

Silica	91.59
Alumina	4.95
Iron peroxide	0.64
Lime	0.07
Magnesia	0.10
Potash	0.10
Soda	0.27
Lithia	0.01
Sulphuric Acid	trace
Phosphoric Acid	trace
Titanic Acid	0.29
Water combined + a little organic matter	1.83
	99.85

III. By treatment with sulphuric acid, the sample, dried at 100° C., yielded for 100 parts :

Sand	86.73
Silica, separated from combination	5.81
Total insoluble matter	92.54

On comparing this result with the total silica in table II., it will be seen that the sand must be nearly pure silica, as has been already indicated by the microscopic examination.

On boiling the sample, dried at 100°, with a solution of sodium carbonate, an unweighable trace of silica only was dissolved.

If we neglect the oxide of iron, which is evidently for e most part free, and also the small quantities of alkaes and alkaline earths, whose exact state of combinaon is here unknown, and calculate the silica, alumina d water to 100 parts, we find that the composition of e clay in the sample approaches closely that which is enerally assigned to kaolinite.

IV.	Clay in B. V. Sand.		Kaolinite.
Silica............	46.15		46.40
Alumina.........	39.32		39.70
Water............	14.53	{ A little organic matter included.	13.90
	100.00		100.00

This also is confirmed by the results of the microscopic xamination, which showed that the clay in the sample composed largely of kaolinite.

The sample is, therefore, nearly pure quartz sand, ixed with a little nearly pure kaolinite.

The material is mainly nearly pure white, tinged ellow here and there with oxide of iron. It is somehat plastic, and when molded retains its form well. It , as the analysis indicates, very refractory. A small ick made of it, and exposed all day to the highest heat tainable in the wind furnace of this laboratory, did not xhibit the slightest tendency to fuse or soften. The red ware was nearly pure white, rather porous and arely fritted together. Before the blow-pipe it became anslucent and slightly rounded on its edges. The rick did not contract on heating, but, on the contrary, ppeared to expand slightly. This argillaceous sand is ndoubtedly a valuable material.

When the clay is washed out, which is easily accomplished, a very good glass sand is obtained.

Without any preparation it will probably make a good molding sand. With very little manipulation, if any, it promises to make fire-bricks which may rival the celebrated Welsh "Dinas bricks," used in construction of certain parts of furnaces where a solid and compact lining is needed, which is not exposed to the action of alkalies or slags rich in metallic oxides. If the addition of a little lime be found necessary to make such bricks, there is an abundance of limestone close at hand. There is, of course, no sand or clay which is good for all purposes or under all circumstances, but as beds of these materials are apt to vary in composition in different portions, it may be well to indicate the possibilities in the case of the Buena Vista deposit by comparing the composition of the present sample with that of molding-sands and Dinas "clay," taken from Percy's Metallurgy.

	1	2	3	4	5
Silica	91.59	91.907	92.913	98.31	96.73
Alumina	4.95	5.683	5.850	0.72	1.39
Iron Peroxide	0.64	2.177	1.249	0.18	0.48
Lime	0.07	.415	traces	0.22	0.19
Magnesia	0.10				
Potash	0.10	....	....	0.14	0.20
Soda	0.27				
Lithia	0.01				
Sulphuric Acid	trace				
Phosphoric Acid	trace				
Titanic Acid	0.29				
Water	1.83	....	....	0.35	0.50
	99.85	100.182	100.012	99.92	99.49

No. 1. Buena Vista Sand.
No. 2. Sand employed at Paris for bronze.
No. 3. Sand of Manchester.
No. 4. Dinas "clay."
No. 5. Dinas "clay."

I think the results of this examination are of importance for the attention of metallurgists and brick-makers to be called to this locality, interesting as it is in so many ways. Very truly yours,

M. B. HARDIN.

It should be noted that this clay would not answer for ordinary furnace lining, as it would be fused by means of the alkalies and slags rich in metallic oxides. There is, however, abundant use for this material in other furnaces.

Dinas bricks made from sandstone as well as clay

The *Dinas bricks*, though originally made from highly silicious clays, are now made from any pure silicious rock, which is ground and mixed with a very small proportion of lime, which in this case acts as a bond for the mass when burned. A closely allied form of material used as a refractory lining for Bessemer convertors is called *ganister*. It is made from quartzite, containing a little aluminous matter, which forms the bond when the material is ground and burned. What are called *fire-stones*, such as were formerly used for hearths of furnaces, etc., are simply very pure silicious sandstones. I mention these facts in order to call attention to the sandstones and quartzites belonging to the Potsdam group as *possibly* adapted to the manufacture of Dinas bricks and ganister. We know that some of them have been successfully used by the Messrs. Jordan for furnace hearths and linings cemented and backed by the local clays. Here is a field worthy of special study.

Ochre and Umber.—The ochres consist of comminuted iron ore mingled with considerable proportions of clay, silica and organic matter. They are of various colors, but most commonly yellow and red. When sufficiently smooth they are used for paints. They generally occur in connection with ore beds, and often constitute the precipitate from the muddy water pumped from iron mines. The inferior paints are sometimes made simply from clay slates and clays colored by iron oxide, but the common iron paints used for roofs, etc., are made by grinding up what we call wash ore.

Umber is a variety of ochre, colored brown by oxide of manganese, which becomes reddish brown by heating.

The conditions on Buena Vista seem favorable for the production of these paint materials, but I am not sure that I saw any beds that would be entirely suitable. In Red Ochre Hollow there is a bank of handsome red clay, which certainly belongs to the ochres, but contains a little fine grit which might be objected to. The yellow clays, many of them, certainly come near being the right thing, and deserve further examination. The red slates underlying the limestone, and some carmine bands in the Potsdam, might answer for the cheaper paints.

Umber also exists in many places, but my experience does not enable me to decide upon its value. The best show I saw was on the east side of the limestone ridge, in a little ravine at the junction of the Jordan ore bed with the limestone and immediately north of Little Chalk Mine Run.

Sand.—I did not see any sand of special value on the high lands of this property, but valuable sand has been found elsewhere along the Blue Ridge, not far away. I quote from Prof. Campbell's Report on the Geology of James River Valley, page 115.

"White sand has been found in large quantities along the western base of the Blue Ridge in Rockbridge County, near Balcony Falls. It forms a bed that intervenes between the upper Primordial shales and sandstones, and seems to have had its origin in the disintegration of a friable sandstone that rests against the base of the mountain, and in some places has been exposed to view in mining for the iron ores of this region. Prof. Rogers says: 'This mineral has every quality suitable for making glass.' Exposures of it occur on the Dover and Brady properties on the North River branch, and on the Glenwood property on the James River branch of the railroad."

(d.) BUILDING STONES.

Limestones belonging to No. II. have been used for houses, chimneys, dams, locks, abutments and culverts without number; and it would be difficult to find a better building stone. The durability is endless, so far as the experience of the country goes. It is so strong as never to have been crushed under any weight put upon it. It is compact, fine-grained and uniform. Its color is blue of different shades, some very pretty. It is easily quarried and easily worked. It is stratified and bedded in sheets of almost any desired thickness; and in this region it stands nearly vertical. Cliffs, especially on South River, present their smooth sides, from which sheets of building stone or curbing may be split off with comparatively little expense.

notable sandstone.

The only *sandstone* in the Potsdam group which has been much quarried for building is the handsome white sandstone which, with an overlying harder bed, underlies the Glasgow ore bed and overlies the great Scolithus bed. This is believed to be a first-class building stone. The sandstone walls found in some of the old locks, and the Court-house steps in Lexington, are said to have come from this bed: the latter from the old quarry on Buena Vista, which I described in the early part of this report as being found on Indian Run, near the head of the pipe line. So far as tested, the stone gives the best evidence of durability. It has some feldspar in it. When fresh it is soft, granulated and beautiful, though becoming dull and yellowish on long exposure. Its color is a slightly cream-white, with minute specks of brown color, which are not conspicuous, but are discernible to the naked eye on close inspection. These may be stains of iron oxide. There are alse narrow black streaks to be seen running at different angles through the body of the rock. These also are doubtless iron oxide, though they have not been known to weaken the rock. With Prof. Harry Campbell I once made a special examination of this line of sandstone, and found an old quarry opened on the bed on the Echols property, near Balcony Falls; and there saw large blocks gotten out without a flaw. It is believed that this sandstone will be used for ornamental work as well as building.

The stone can be reached from almost any direction, front, rear or edge; the local conditions in each case indicating which approach would be the most eligible. It stands at a high angle crossing the spurs, and presenting its edge to the valleys. Beneath it is shale, and over it is a thin bed of flaggy sandstone.

(e.) HYDRAULIC CEMENT LIMESTONES, ORDINARY LIMESTONES, LIME AND MARL.

Strength of t Rockbridge Cement.

The quality of the Rockbridge cement has been tested and proved by over forty years of most satisfactory and unimpeachable trial. Forty odd years ago it was used to cement the stones in the canal locks, and it is said that the joints are to-day as hard as the rock, and in some places harder.

The limestone from which this is made is found in two separate beds, both in the No. II. group. They both cross the Buena Vista property, but have not been opened or tested in any way.

Flux cheap a abundant.

Limestones for building uses have already been mentioned. Much of the stone of this group has too much silica and magnesia in it for the best results in making lime, or for furnace flux. But it is said that some of the beds are good for lime and also for flux. The two uses require a similar quality of stone. Limestone was shipped at one time for the furnace at Roanoke from below Loch Laird. The purest limestone of our Valley is the grey bed worked by Dillon below Buchanan, and to be found in abundance near Lexington.

Considerable beds of tufaceous marl, which runs high in carbonate of lime, are common on the small streams emptying into both South and North Rivers. Whether this would bear the burden in a high stack is thought to be doubtful. It answered well in the old Buena Vista furnace.

Thus endeth my discussion of the mineral wealth of this great property.

FORESTS.

The forest area of 10,000 acres is in an unbroken body, beginning on the mountain crest, including all the high ridges, peaks and spurs, and covering all the table-lands and foot-hills, until the cleared lands on the river-hills and bottoms are reached. This is the coaling ground for the old Buena Vista furnace. As the furnace was destroyed in 1864, and not rebuilt, the youngest part of the forest must be at least 25 years old. From this date the age of the growth grades back into virgin forest. Capt. C. F. Jordan estimates the available area of virgin forest at 1,000 acres. This lies on the front nearest to the rivers, and consists of oak, hickory and pine chiefly. Much of it is mill timber, and there is now a steam saw-mill at work upon it. The area that was coaled over lies between the virgin forest and the steep mountain. It makes a belt four miles long and something over one mile wide. The second growth is very dense, and miscellaneous in character, chiefly composed of the hard woods, which indicate a strong soil. A poor soil generally sends up a growth of scrubby pines. Here we have all the oaks of this region, with a good proportion of white oak on the lower lands, and of chestnut oak on the high ridges. The smooth hickory is liberally interspersed. There is some tulip poplar, ash, sycamore, pine, white walnut, cedar, dogwood and quite a large proportion of

Varieties of trees.

chestnut. The trees are, of course, small in size, but they are growing vigorously, and have been but little injured by fires.

The trees on the precipitous mountain sides and in the ravines are not generally large, and yet on the clays there are areas of good-sized timber, and much of it accessible. The tops of the mountains are generally well wooded with timber of medium size. I was struck with the richness of the forest on the top and east side of Chimney Rock mountain.

Good roads every direct

Engineer ability d played by former own

This great forest is rendered accessible on all practicable ground by well-graded and generally smooth roads in every direction. I could but admire the fine engineering ability displayed in the location of these roads; and the Jordan road across the Blue Ridge at White's Gap is, I think, a marvel of engineering skill. It is fortunate that this large property was, in former times, handled by such men as the Jordans—a race of natural engineers, going back to Col. John Jordan, an engineering king, whose solid structures are everywhere to be seen defying the tooth of time.

Coal hearth

Old coal hearths, well located, chiefly by Capt. C. F. Jordan, are liberally dotted over the property. Both these and the roads could soon be made ready for service at small expense.

What shoul done with great forest

What ought to be done with this vast forest is not for me to say. If a charcoal furnace is wanted, there is no place on earth where it could be supplied with stock more cheaply. The mill timber for building is all wanted right now. The young forest is paying a good interest on the investment by just letting it alone. Timber becomes more valuable year by year, not only by growing larger, but by its increasing scarcity. The Western and Northern States, that overwhelm us with their wooden manufactures, will soon do as the paper mills and tanneries are doing, come to us for their stock, instead of transporting it to the factory from the ends of the earth. These countless young chestnuts, which are growing vigorously, will soon be wanted, not only for fencing, but for furniture and house-finishing. And these abundant white oaks and hickories will all be wanted for a hundred uses; and so with everything that is growing here. An easily-accessible forest of 10,000 acres of good timber (as this will become) is something very different in its attractive power from a multitude of small and scattered tracts, attached perhaps to farms. I say this for the protection of this wealth of young timber. Let it alone until it is really wanted. Of course timber must be had for the mines and a variety of miscellaneous uses; but under judicious management this may be culled out in such a way as to improve the forest. And so millions of hoop-poles could be culled out with advantage, and could be made profitable in connection with barrel factories at Buena Vista.

.et it alone.

WATER AND WATER POWER.

Referring to what I said in regard to the water supply under the head of Topography, I here add that in order to obtain a steady supply for washing ore in the area where most mining will be done, it would be necessary, for the greatest economy, to impound the water at various points convenient to the mines, or else to bring it by artificial means from a distance. I will only suggest the possibility of obtaining abundant supplies of

Conditions f
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tesian wells.

water for ordinary purposes by means of artesian wells. It will be remembered that all the mountain rocks have a uniform dip to the north-west, which would direct westward and downward all the water which sinks beneath the surface occupied by them. Hence, inasmuch as their tops rise a thousand feet above the level of the river, the conditions are right for artesian wells, unless there be dislocations, of which I have seen no evidence. Such wells should be bored, if at all, near the lower end of the valley of Chalk Mine Run. It might be necessary to go through the first heavy bed of sandstone, which would probably necessitate a well of not less than a thousand feet. But when struck the water would probably rise with great force to any height which would be required about the town or the ore mines of that neighborhood.

Such wells would be unnecessary now, in view of the supplies which could be piped from no great distance. A line of pipes from Irish Creek has been suggested. This would give an abundant supply of water for all the uses of the town; for washing ore at every point where it may be wanted, for hydraulic sluicing, and for the use of miners, choppers, and steam machinery.

Abundant w
ter power
South a
North River

Large pow
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There is abundant water power on South and North Rivers. I do not know the exact volume of water in either, but from the mouth of Irish Creek to Loch Laird there is said to be a fall of about 200 feet. A large proportion of this could be controlled by the Buena Vista Company. The old furnace race leaving South River near Riverside Station gave a fall at the stack of about 25 feet, as Captain Jordan informs me. The company, I am told by President Barclay, has control of three dams on North River, and could obtain more if wanted. Such power used directly on mill wheels, or on dynamos, for the creation of electric power, which could be transmitted to any point where it might be wanted, insures the Buena Vista property whatever motor power may be needed for machinery of all sorts, large and small, and for the generation of electric light.

AGRICULTURAL LANDS.

Except the Hart's Bottom and Green Forest farming lands, which have been set apart for city uses, and the fine old Buena Vista plantation, on which is the old furnace and the handsome residence of the former proprietor, Samuel F. Jordan, Esq., and which includes not only the bottom lands and hills on the east of South River, but also the large fields on the top and sides of Timber Ridge, there is not much cleared land on the Buena Vista territory. But there are thousands of acres of land now in timber which might be converted into good farms, and ultimately, of course, will be. So that when the time comes for denuding them of their forests, the soil that is left will no doubt have a greater value than the same land is now rated at. The lands referred to are the plateaux, spurs, low ridges and foot-hills generally which have been so often mentioned already in this Report.

baronial landed estate.

The soils are based on the clays of the Upper Potsdam and Lower Limestone groups. It is all now so filled with vegetable matter as to insure its uniform productiveness under the plough, but of course there will be variations in the durability of these soils, depending upon the extent to which the leaching out of their alkalies has gone, and the amount of sand and other wash that has come down from the mountains. As originally constituted, these Potsdam slates are abundantly supplied with all the mineral elements needed to make first quality land, and I doubt not that thousands of acres under a clover and cattle system, in connection with cereal farming, will make permanently fertile soil.

All the mineral elements of good land.

The double advantage of the forest and the land beneath the forest, if rightly considered in connection with the mineral wealth, will show that the price paid for the great estate was quite small in comparison with its intrinsic value.

A cheap property.

MISCELLANEOUS TOPICS.

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oads.

Before concluding this Report, I think it relevant to comment upon what might be regarded as incidental topics, but which really enter as important natural elements of value. Whilst this section of the country has no mineral *coal*, it is within commercial range of three of the four great coke-producing centres of the United States, viz., the Pocahontas, the Quinnemont, and the Connellsville mines and ovens. These are reached by competing lines of railway. It is expected that coke of the best quality can be delivered at Buena Vista at about $3 per ton. And the great Pittsburg coal bed, which furnishes the Connellsville coke, and which extends across West Virginia, will furnish coke at some future time at points nearer than Connellsville. The railway which has been projected to connect the Lexington branch of the Richmond and Alleghany Railroad with Pittsburg, will probably be made at some future time, and by this road these nearer coke-producing points on the Pittsburg coal seam will be reached. These considerations, I think, fully meet the question of fuel for furnaces and other manufacturing purposes at Buena Vista.

limate.

Climate is, of course, a matter of prime importance in connection with human residence everywhere. I presume that no intelligent person who is acquainted with the climate of the Valley of Virginia will regard as extravagant the statement, that its climate is not surpassed for residence all the year round.

Scenery.

Fine scenery has commercial value, appealing as it does to the same esthetic faculty which is gratified by beautiful creations of art; and this element will be increasingly valued with the progress of refinement. The sculpture of the Blue Ridge is unique, and quite different from that of North Mountain and the Alleghany. It is bolder, more varied and more impressive; and its exhilarating effects upon the beholder are never lost. The North Mountain scenery is very beautiful, but calmer. From the Hart's Bottom plain the circle of vision is contracted, but still interesting, the surrounding elevations being varied, and from this position the observer gets the full effect of each of the lofty peaks and wild gorges which border the town limits. The view from the hotel is one of singular beauty, with features of grandeur. Distant mountains and hills are brought into the landscape, North River glistens from its bower of trees, and a long line of Blue Ridge peaks, high ridges and wild ravines flank the picture on the east. All around stand eminences affording new scenes. And on Timber Ridge and the high mountains near by, at points which may be reached on horseback, and some of them in carriages, one may look over a wide panorama, taking in the House Mountain, Hog Back, Jump, Purgatory and many others whose presence is much more beautiful than their names.

Remarkabl
fine scene

I am acquainted with many, many points of interest in Virginia and elsewhere, and have a right to say that there are few spots presenting so many features of interest to the lover of nature as this. Many short excursions also could be made from here to objects rare and interesting—such as Crab Tree Falls, Balcony Falls, Natural Bridge, Clifton Forge, Luray Cave, and Lexington,

Excursions

whose institutions and historical associations give it unusual attractiveness. And it is not far to the spot on James River which has fishing advantages sufficient to have induced the President of the United States to come there to try his luck.

ield for the eologist and otanist.

I will only add that the geologist and botanist could scarcely find a better spot than this for the study of their special branches. The geologist will find the Archæan rocks on one side of the mountain and the Lower Silurian on the other. I know of no other locality where the Potsdam and Canadian groups are so well exposed as here in the mountain gorges and along the river cliffs. The geological cross section made by "Campbell and Ruffner" twenty years ago, crosses White's Gap and passes the old Buena Vista furnace. The Rockbridge tin mines are in property adjoining Buena Vista on the north.

CONCLUSION.

I think that the facts herein presented vindicate the strong expressions which I repeatedly use in this Report concerning the value and attractions of the Buena Vista property. I might have said much with regard to the industrial and mercantile advantages and prospects of the young city, but do not regard this branch of the subject as included in my province.

W. H. RUFFNER.

LEXINGTON, VIRGINIA, August 30, 1889.

SUPPLEMENTARY STATEMENT.

LATEST DISCOVERIES ON BUENA VISTA MINERAL LANDS.

My examination of the Buena Vista property ended about six weeks ago, since which time prospecting along the lines of iron ore has been continued with a small force, and with entirely favorable results on every line.

A tunnel has been run into the Hays ore at the old bank, a little above the level of Chalk Mine Run. The ore was reached after passing through 30 to 40 feet of clay, and was found to be rich and abundant; but the bed has not been cut through, the miners having found it necessary to stop and timber the tunnel.

On the top of the ridge, immediately above the Hays bank, a wide cut has been made, in which the ore was reached near the surface, lying flat on top of the ridge, just as it does in a cut 100 yards lower down along the crest; on which latter I remarked in my Report as an indication either that here is the top of the arch which originally connected this bed with the Moomaw, or else that the outcrop simply fell over westward, when deprived of its supporting clay by the weather, and was subsequently covered by wash from the higher parts of the ridge. The latter is probably the true explanation. The ore in this new exposure is much leaner than that near the bottom of the ridge, a fact which I commented upon as affording evidence that the ore beds become richer and relatively less silicious as they descend into the earth.

The Jordan ore bed has been opened somewhat imperfectly in two places, one of which is within the first mile, and one on Lowman's Ridge, beyond the first mile. The first opening is at the head of the Dry Fork of Lost Hollow, where the bed shows the same excellent quality which was shown by Prof. Hardin's analysis. The opening is not sufficient to display the bed properly. Its thickness seems to be from 10 to 20 feet, but I cannot be sure of this. There is a clay break at one end, which at that point cuts off the ore, but of course farther digging would reach it again. This is the first sight I have ever gotten of this bed in place. The former owners, so far as I could discover, had never dug into this bed, except on the hill immediately north of Big Chalk Mine Run, and these old cuts have now fallen shut.

The other new opening on this lead is on Lowman's Ridge, where a tunnel has penetrated a large bed of ore, which seems to be the Jordan ore. and yet is a little west of the true course of this bed. I suspect that it is a slide from the outcrop of the bed, and that the true bed lies further on, and will be reached after a few days' more digging. The heading of the tunnel is still in ore, and ore of very superior quality, compact, brown, with red tinge; so high in iron that some lumps, I think, would show 60 per cent. metallic iron. There is evidently but little silica.

Before reaching the ore, a bed of manganese was cut through, which confirms me in a suspicion which I had during my former examination, viz., that there is a bed of manganese between the Jordan ore and the limestone. The manganese here is about 5 or 6 feet thick, but decomposed and mixed with clay.

The Leake (or "40-foot") bed has been opened at three new places, and in every case it shows large and good. The first place is on the hill north of Little Chalk Mine, where the first limestone shows so boldly. This opening has been dubbed "Ruffner" by President Barclay. It measures 28 feet across, and seems to be solid all the way. The quality is unimpeachable.

In the first hollow beyond this is another opening on the same lead, called Pechin. Here we found a miner uncovering the ore, which, as in other cases, carries but little overburden of earth. The bed now shows protuberances of ore about 20 feet across, with clay partings, which will probably disappear in a few feet; and no doubt the bed will show a greater breadth after a little more digging.

The third opening is perhaps a quarter of a mile further on, on Big Cut Ridge. This we call the Thomas bed. It is 28 feet across, the ore heavy, brown and liver-colored, with the vermilion clay alongside. There may be another equally good new cut on this Leake bed, but I do not remember it clearly.

By reference to the body of my Report, it will be seen that I describe an old tunnel on the McCorkle bed, on Deep Cut Ridge, immediately south of Red Ochre Hollow. The ore in the tunnel had been penetrated only about 2 feet. Nothing more has been done to this, but in the open cut above, where I could formerly see only one projection of ore, the bed has been cleared off and now shows a fine solid face of ore 25 feet across, with the probability of several feet more of thickness. Much of this ore is specked with silica, but it will come readily within the furnace limit, and is evidently better in quality than the same bed on Mineral Ridge. We named this Seddon.

A new opening has also been made on the McCorkle lead, 100 yards or more south of the Seddon opening. This is a grand development, 42 feet in width, apparently solid and containing much the best quality of ore that has been found on this lead. Much of the ore is aluminous, without appearance of silica, and vermilion in color. It is of the kind that usually would be called Red Shale ore. It is compact and smooth. I shall look with interest for the analysis of this ore. We named the bed Clark.

Quantity of Ore.

In my Report under the heading " Quantity of Ore," I understated, as I believed at the time, the thickness of every bed; but it is now evident, in respect to the three leads of ore which have just been mentioned, I so far understated their thickness that simple justice requires me now to increase my estimates. With a caution which is now proved to have been excessive, I gave the Leake bed an average thickness of 10 feet only. There are now five openings on it, scattered along the lead for a mile and a quarter, not one of which shows a thickness so low as 20 feet, and the probabilities are that when fully uncovered the average thickness of the lead will prove to be 25 to 30 feet for more than a mile and a quarter. What it may prove to be beyond that remains to be discovered.

The McCorkle bed having been opened at but one place, I allowed it in my Report only a thickness of less than 6 feet, but now we have two other openings, over a mile from the first, which gives us a thickness of 25 to 30 feet at one place and 42 feet at another.

It will be remembered that I estimated the consumption of ore of a 100-ton furnace for 20 years to be equal to a block of ore 1 mile long, 40 feet wide, and 100 feet deep. From present indications, it is not unreasonable to believe that the Leake and McCorkle beds alone would feed such a furnace for 20 years in the first mile.

It may also be remembered that, owing to the wholly undeveloped condition of the Jordan bed, I simply threw that in, along with the Moomaw, etc., as an unknown quantity for filling vacancies. The indications now are that this is a bed of 10 feet or more in thickness of first quality ore.

Final Remarks.

The Glasgow and Moomaw beds remain wholly undeveloped. Nothing more has yet been done on the Barclay, Miller and McKee beds, and nothing more on the Colonial than the work at the Hays bank, except the pumping out of the Water Hole, and the opening of a now unfinished side drift near the bottom of the old shaft. Concerning the undeveloped lines and parts of lines, we have as much reason to hope for large openings on nearly all of them as we had for those which I have described above.

Hence we need not confine our view to one furnace, to be fed from Buena Vista ores, but may look forward to two or more. Perhaps the realization of the future will exceed anything I now would dare to predict.

It will be gratifying to the friends of the Buena Vista enterprise to know that a first-class furnace has been contracted for, and that many new houses are going up in the town, whilst a still larger number will soon be commenced.

The Steam Saw Mill is busily at work in the forest, and the experienced lumber man in charge speaks highly of the timber as to both quantity and quality.

W. H. RUFFNER.

LEXINGTON, VA.,
October 9, 1889.

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